FANNING HOWEY

WRIGHT STATE UNIVERSITY

Project Manual
For

Wright State University
Board of Education

Lake Campus Workforce Development Project

Dayton, Ohio 45327
Project No. 224102.00

03 September 2026

PROJECT TITLE PAGE

LAKE CAMPUS WORKFORCE DEVELOPMENT PROJECT
7600 LAKE CAMPUS DRIVE
CELINA, OHIO 45822

Direct Questions and Substitutions Concerning This Project To:

Architects/Engineers

Fanning/Howey Associates, Inc.
128 West Market Street
Celina, OH 45822
Phone No. 419/586-7771
FAX No. 419/586-2141

Site/Civil Engineer

Access Engineering Solutions
1200 Irmscher Boulevard, Suite B
Celina, Ohio 45822
Phone No. 419-586-1430

Structural Engineer

Jezerinac Geers & Associates, Inc.
5640 Frantz Road
Dublin, Ohio 43017
Phone No. 614-766-0066

S E T N O. _____ __

END OF PROJECT TITLE PAGE

CERTIFICATIONS PAGE

TITLE AND LOCATION OF THE WORK

Lake Campus Workforce Development Project
7600 Lake Campus Drive
Celina, Ohio 45822

NAME AND ADDRESS OF OWNER

Wright State University
3640 Colonel Glenn Highway
Dayton, Ohio 45435-0001

NAME AND ADDRESS OF ARCHITECTS/ENGINEERS

Fanning/Howey Associates, Inc.
128 West Market Street
Celina, OH 45822

I hereby certify that the Project Drawings and the Project Manual were prepared by me or under my direct supervision and that I am a duly registered Architect/Engineer under the Laws of the State of Ohio.

FANNING/HOWEY ASSOCIATES, INC.
ARCHITECTS/ENGINEERS



JENNIFER M. FULLER, License # 1115297
Expiration Date 12/31/27

Date: September 3, 2026

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State of Ohio Standard Forms and Documents

WSU-231035
Lake Campus Workforce Development Project
Wright State University
Celina, Mercer County

Bids Due: 2:00 pm local time, November 4, 2026, through the State's electronic bidding system at https://bidexpress.com
EDGE Participation Goal: 5.0% of contract
Domestic steel use is required per ORC 153.011.

Contract	Estimated Cost
General Contract	$4,447,383.00
Alternate No. 1 – Room Nos. 108A and 108B	68,000.00
Alternate No. 2 – Temperature Control Systems	66,000.00
Alternate No. 3 – West Entrance Canopy	9,700.00
Alternate No. 4 – Screening Mechanical Yard	10,000.00
Alternate No. 5 – Refinish Room	25,000.00
Alternate No. 6 – Landscaping	16,000.00

Pre-bid Meeting: October 21, 2026, 10:30 am, Wright State University – Lake Campus, 7600 Lake Campus Dr., Celina, Ohio 45822 at 102 Dwyer Hall.
Bid Documents: FREE to download electronically at https://bidexpress.com. Registration is required.
More Info: A/E contact: Fanning Howey, Rodney Wiford, Phone: 419.586.7771, E-mail: rwiford@fhai.com

-------- end of advertisement—do not publish this line ----------

APPROVED FOR PUBLICATION
In:
On:

Ohio Facilities Construction Commission

Name
Project Coordinator

Date

RECEIVED BY:

Type or print name of authorized representative

Signature

Date

autoinsert path and filename – use 7 pt Ariel

General Info

Electronic signature required

Deadline

11/10/2026 02:00 PM EST

Advertised

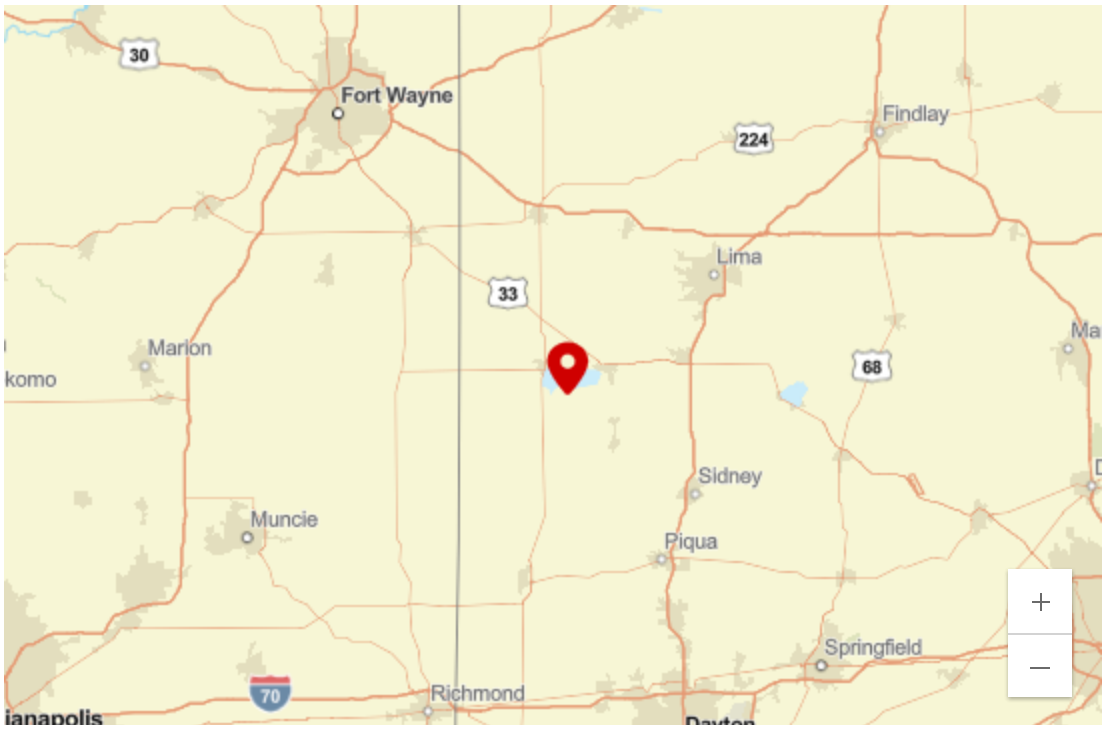
10/11/2026 12:01 AM EDT

Business Name

Wright State University - Design and Construction

Location(s)

7600 Lake Campus Dr, Celina, Ohio, 45822



Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS Powered by Esri

Number

WSU-231035 Lake Campus Workforce Development

Description

WSU-231035 Lake Campus Workforce Development for Wright State University Lake Campus located at 7600 Lake Campus Dr., Celina, OH 45822.

All interested Bidders are strongly encouraged to attend the Pre-Bid meeting on October 21, 2026 at 10:30 am. Meeting location: 102 Dwyer Hall.

Bids will be due on November 4, 2026 no later than 2:00 p.m. This project is estimated at a cost of $4,447,383.00 for General Base Bid. Bids will also be received for the following alternates:

Alternate No. 1 – Room Nos. 108A and 108B	$68,000.00
Alternate No. 2 – Temperature Control Systems	$66,000.00
Alternate No. 3 – West Entrance Canopy	$9,700.00
Alternate No. 4 – Screening Mechanical Yard	$10,000.00
Alternate No. 5 – Refinish Room 133	$25,000.00
Alternate No. 6 – Landscaping	$16,000.00

The Project Documents may be downloaded as PDF files from the State's electronic bidding service at https://bidexpress.com at no charge, registration is required. Submit Bids through the State's electronic bidding system at https://bidexpress.com for the following: WSU-231035 Lake Campus Workforce Development, in accordance with the Contract Documents prepared by Fanning Howey, 128 West Market Street, Celina, OH 45822 Contact: Rod Wiford, rwiford@fhai.com.

Bidders may submit requests for consideration of a proposed substitution for a specified product, equipment, or service to the Architect/Engineer ("A/E") no later than 10 days prior to the bid opening. Prevailing Wage rates and Equal Employment Opportunity requirements are applicable to this Project. The EDGE Participation Goal for the Project is 5.0 percent. Bid tabulations will be posted no later than 5:00 p.m. on the day Bids are opened.

Allows zero unit prices and labor
Yes

Allows negative unit prices and labor
Yes

Solicitation Summary

AI generated | Quality may vary

This is a commercial building construction project involving a new 10,000 square foot Workforce Development Center at Wright State University Lake Campus in Celina, Ohio. The project includes concrete, HVAC, electrical, plumbing, fire suppression, and site work. May require general contracting experience and bonding capacity.

Work Types

New Construction Building Building System Landscape & Vegetation

Q & A

Deadline

Same as solicitation deadline.

Remarks

Procurement Documents

00 11 00 M299-03-Public-Bid-Advertisement-eBid.docx (24.5 KB)

224102.00_WSU_CD Drawings.pdf (50.6 MB)

224102.00_WSU_CD Project Manual.pdf (22.8 MB)

Contract Times and Addenda

Contract Times

The time for completion of Milestone 1 is NNN consecutive days from the Commencement Date in the Notice to Proceed.

The time for completion of Milestone 2 is NNN consecutive days from the Commencement Date in the Notice to Proceed.

The time for completion of Milestone 3 is NNN consecutive days from the Commencement Date in the Notice to Proceed.

The time for completion of Milestone 4 is NNN consecutive days from the Commencement Date in the Notice to Proceed.

The time for Substantial Completion of all Work is NNN consecutive days from the Commencement Date in the Notice to Proceed.

Acknowledgement of receipt of Addenda

Date Addendum #1 Received	Date Addendum #2 Received	Date Addendum #3 Received	Date Addendum #4 Received

Date Addendum #5 Received	Date Addendum #6 Received	Date Addendum #7 Received	Date Addendum #8 Received

Unit Price Instructions

Enter the price per unit of measure in the Bid Form and the extension will automatically calculate. Include the Extension for each and every Unit Price in the Base Bid. Unit prices will be used solely for the purpose of determining the adjustment to the Contract Sum for differences between the estimated quantities on the electronic Bid Form and the actual quantities provided.

Unit Prices (General Contract)

Item	Description	Quantity	Unit Price	Unit Of Measure
Unit Price U-1	Unsatisfactory Soil Removal	0.0		Cubic Yards

Base Bid Instructions

Enter the amount of the Base Bid for all Labor and Materials to complete the scope of Work. Include the amount of each Allowance (if applicable) and the subtotal of Unit Price Extensions (if applicable) in the Base Bid amount. Failure to include Allowances or Unit Price Extensions in the Base Bid is the responsibility of the Bidder and will not be sufficient reason for adjustment of the Bid amount after the Bid deadline. Do not include Alternates (if applicable) in the Base Bid amount.

Base Bid (General Contract)

Item	Description	Base Bid Amount

Item	Description	Base Bid Amount
Base Bid	All Labor and Materials (including Allowances and Unit Price Extensions above)	

Alternate Instructions

Enter the amount of each and every Alternate to ADD TO or DEDUCT FROM the Base Bid. Indicate amounts to DEDUCT FROM the Base Bid by entering a minus sign (-) before the amount entered. Do not include Alternate amounts in the Base Bid.

Alternates (General Contract)

Item	Description	Alternate Amount

Alternate: Owner-agency may award independently from entire bid.

Alternates are not included in bid total.

Alternate 1	Corridor 108 A & B
Alternate 2	Additional Temperature Controls
Alternate 3	Replace Canopy
Alternate 4	Mechanical Screen Wall
Alternate 5	Replace Finishes, 133
Alternate 6	Provide all Landscaping

Required Document List

Name	Omission Terms
Document 00 43 13 - Bid Security Form https://ofcc.ohio.gov/static/Portals/0/Documents/AgrmntsStdRqrmnts/GeneralContracting/M1…	

1 Required Document

Bidder Affirmation and Disclosure

The Bidder acknowledges that by submitting its Bid, the Bidder has read and understands the applicable Executive Orders regarding the prohibitions of performance of offshore services, locating State data offshore in any way, or purchasing from Russian institutions or companies. If awarded a Contract, the Bidder will become the Contractor and affirms that both the Contractor and its Subcontractors shall perform no services requested under this Contract outside of the United States.

The Bidder shall provide the locations where services under this Contract will be performed in the spaces provided below or by attachment. Failure to provide this information as part of its Bid may cause the Bidder to be deemed non-responsive and no further consideration will be given to its Bid. If the Bidder will not be using Subcontractors, indicate "Not Applicable" in the appropriate spaces.

1. Principal business location of Contractor:

Contractor Address*

City, State, Zip*

Name / Principal business location(s) of Subcontractor(s), if known at time of Bid deadline:

Subcontractor Name

Address, City, State, Zip

2. Location(s) where services will be performed by Contractor (Project Sites):

Address*

City , State, Zip*

Name(s) / Location(s) where services will be performed by Subcontractors (Project Sites):

Subcontractor Name

Address, City, State, Zip

3. Location(s) where State data will be located by Contractor:

Address*

City, State, Zip*

Name / Locations where State data will be located by Subcontractor(s), if known at time of Bid deadline:

Subcontractor Name	Address, City, State, Zip

Bidder also affirms, understands and agrees that the Contractor and its Subcontractors are under a duty to disclose to the State any change or shift in location of services performed by the Contractor or its Subcontractors before, during and after execution of any Contract with the State. Bidder agrees it shall so notify the State immediately of any such change or shift in location of its services. The State has the right to immediately terminate the contract, unless a duly signed waiver from the State has been attained by the Contractor to perform the services outside the United States.

On behalf of the Bidder, I acknowledge that I am duly authorized to execute this electronic Bid Form including this Bidder Affirmation and Disclosure form and have read and understand that this form is a part of any Contract that Bidder may enter into with the State and is incorporated therein.

EDGE Program Commitment to Participate

Option A

The Bidder commits to meet or exceed the advertised EDGE Participation Goal of the Contract award amount, calculated as a portion of the Base Bid plus all accepted Alternates, by using EDGE-certified Business(es).

The Bidder agrees that if selected for consideration of the Contract, it shall provide (if not provided with the Bidder's Bid) to the Contracting Authority, at the location required and within 3 business days after receiving notice from the Contracting Authority, its fully completed Bidder's Qualification Form, including an EDGE Affidavit form for each EDGE-certified Business proposed for use by the Bidder if awarded the Contract for this Project.

Option B (indicate percentage of participation below)

The Bidder declares that it does not meet the advertised EDGE Participation Goal percentage, but, if awarded the Contract for this Project, commits to provide the percentage of the Contract award amount, indicated above, calculated as a portion of the Base Bid plus all accepted Alternates, by using EDGE-certified Business(es).

The Bidder acknowledges it understands the requirement for it to provide and agrees to provide to the Contracting Authority, if selected for consideration of the Contract, within 3 business days after notice from the Contracting Authority, a detailed Demonstration of Good Faith form describing its efforts undertaken prior to submitting its Bid to meet the advertised EDGE Participation Goal percentage for the Contract for this Project.

The Bidder commits to provide to the Contracting Authority at the location required, and within 3 days after receiving notice from the Contracting Authority, its fully completed Bidder's Qualifications Form, including an EDGE Affidavit form for each EDGE-certified Business proposed for use by the Bidder if awarded the Contract for this Project.

Option C

The Bidder declares that the Bidder is an EDGE-certified Business and that if awarded this Contract, the EDGE Participation percentage will be 100 percent of the Contract award amount.

Select EDGE Option above*

Choices...

If Option B selected, enter percentage

Certifications (State Prevailing Wages)

1. The Bidder has read and understands the proposed Contract Documents and agrees to comply with all requirements of the proposed Contract Documents, regardless of whether the Bidder has actual knowledge of the requirements and regardless of any statement or omission made by the Bidder, which might indicate a contrary intention.

2. The Bidder represents that the Bid is based upon the Basis of Design and Acceptable Components specified by the proposed Contract Documents.

3. The Bidder has visited the Site, become familiar with local conditions, and has correlated personal observations about the requirements of the proposed Contract Documents. The Bidder has no outstanding questions regarding the interpretation or clarification of the proposed Contract Documents.

4. The Bidder understands that the execution of the Project will require sequential, coordinated, and interrelated operations, which may involve interference, disruption, hindrance, or delay in the progress of the Bidder's Work. The Bidder agrees that the Contract Sum, as amended from time to time, shall cover all amounts due from the State resulting from interference, disruption, hindrance, or delay that is not caused by the State or its agents and employees. The Bidder agrees that any such interference, disruption, hindrance, or delay is within the contemplation of the Bidder and the State and that the Contractor's sole remedy from the State for any such interference, disruption, hindrance, or delay shall be an extension of time in accordance with the proposed Contract Documents.

5. During the performance of the Contract, the Bidder agrees to comply with Ohio Administrative Code ("OAC"□) Chapters 123:2-3 through 123:2-9 and agrees to incorporate the monthly reporting provisions of OAC Section 123:2-9-01 into all subcontracts on the Project, regardless of tier. The Bidder understands the State's Equal Opportunity Coordinator or the Contracting Authority may conduct pre-award and post-award compliance reviews to determine if the Bidder maintains nondiscriminatory employment practices, maintains an affirmative action program, and is exerting good faith efforts to accomplish the goals of the affirmative action program. For a full statement of the rules regarding Equal Employment Opportunity in the Construction Industry, see OAC Chapters 123:2-1 through 123:2-9.

6. The Bidder and each Person submitting a Bid on behalf of the Bidder certifies, and in the case of a Bid by a joint venture each member thereof certifies as to such member's entity, under penalty of perjury, that to the best of the undersigned's knowledge and belief: (a) the Base Bid, any Unit Prices, and any Alternate bid in the Bid have been arrived at independently without collusion, consultation, communication or agreement, for the purpose of restricting competition as to any matter relating to such Base Bid, Unit Prices or Alternate bid with any other Bidder; (b) unless otherwise required by law, the Base Bid, any Unit Prices and any Alternate bid in the Bid have not been knowingly disclosed by the Bidder and shall not knowingly be disclosed by the Bidder prior to the bid opening, directly or indirectly, to any other Bidder who would have any interest in the Base Bid, Unit Prices, or Alternate bid; (c) no attempt has been made or shall be made by the Bidder to induce any other Person to submit or not to submit a Bid for the purpose of restricting competition.

7. The Bidder shall execute the Agreement with the Contracting Authority, if a Contract is awarded on the basis of this Bid, and if the Bidder does not execute the Agreement for any reason, other than as authorized by law, the Bidder and the Bidder's Surety are liable to the State as provided in Article 5 of the Instructions to Bidders.

8. The Bidder certifies that the upon the award of a Contract, as the Contractor it shall make a good faith effort to ensure that all of the Contractor's employees, while working on the Site, shall not purchase, transfer, use, or possess illegal drugs or alcohol or abuse prescription drugs in any way.

9. The Bidder acknowledges that it read all of the Instructions to Bidders, and in particular, Section 2.10 - Submittals With Bid Form, and by submitting its Bid certifies that it has read the Instructions to Bidders and it understands and agrees to the terms and conditions stated in them.

10. The Bidder agrees to furnish any information requested by the Contracting Authority or Architect/Engineer to evaluate the responsibility of the Bidder.

11. The Bidder agrees to furnish the submittals required by Section 6.1 of the Instructions to Bidders for execution of the Agreement within 10 days of the date of the Notice of Intent to Award.

12. When the Bidder is a corporation, partnership or sole proprietorship, an officer, partner or principal of the Bidder, as applicable, shall enter the legal name of the Bidder and the name of the officer, partner or principal of the Bidder (in lieu of signing the Bid Form) in the data fields provided.

13. When the Bidder is a joint venture, an officer, partner or principal, as applicable, of each member of the joint venture shall enter the legal name of the applicable member and the name of the officer, partner or principal (in lieu of signing the Bid Form) in the data fields provided.

14. The Bidder understands that the Contract is subject to all the provisions, duties, obligations, remedies and penalties of Ohio Revised Code Chapter 4115 and that the Bidder shall pay any wage increase in the locality during the term of the Contract.

15. The Bidder represents that the individual that is submitting and digitally signing the electronic Bid is legally authorized to do so.

16. Bidder acknowledges that by the act of submitting an electronic Bid that it is digitally signing the actual Bid, which shall serve as the Bidder's authorization for the further consideration and activity in the bidding and contract process.

☐ **The Bidder hereby acknowledges that the above representations in this Bid are material and not mere recitals:**

*

Procurement Forms

Document 00 43 13 - Bid Security Form

Upload below and provide original document within 3 days

Document 00 45 13 - Bidder's Qualifications

Upload below or provide within 3 days of request

Document 00 45 39 - EDGE Affidavit

Upload below or provide within 3 days of request

Instructions for Providing Bid Submittals

Submission of Electronic Facsimile of Bid Guaranty with Electronic Bid

The Bidder SHALL UPLOAD and ATTACH TO ITS BID an ELECTRONIC FACSIMILE (scanned PDF document) OF ITS BID GUARANTY, payable to the Contracting Authority, in the form of either: (1) the signed and sealed Document 00 43 13 - “Bid Security Form” contained in the Contract Documents (and provided for the Bidder's convenience in the block above) for the amount of the Base Bid plus all additive Alternates; or (2) a certified check, cashier's check, or letter of credit, for 10 percent of the Base Bid, plus all additive Alternates – a letter of credit shall expressly provide that it is revocable only by the Contracting Authority. Refer to Sections 2.10.1.1 and 5.1 of Document 00 21 13 - "Instructions to Bidders."

Submission of Original Bid Guaranty

In addition to the Electronic Facsimile above, the Bidder SHALL DELIVER ITS ORIGINAL UNALTERED BID GUARANTY to the Project Coordinator at the address identified below WITHIN 3 BUSINESS DAYS AFTER THE BID DEADLINE as provided in Ohio Administrative Code Section 153:1-8-01(H). THIS REQUIREMENT APPLIES TO ALL BIDDERS. Refer to Section 2.10.1.2 of the Instructions to Bidders.

Robert Thompson
University Architect
Wright State University
3640 Colonel Glenn Hwy
Allyn Hall 069A
Dayton, OH 45435

Non-responsive Bid for Failure to Submit Bid Guaranty

Each Bidder MUST SUBMIT BOTH THE ELECTRONIC FACSIMILE AND THE ORIGINAL UNALTERED BID GUARANTY as described above. The Contracting Authority SHALL REJECT A BID AS NON-RESPONSIVE if the Bidder fails to submit BOTH elements of the Bid Guaranty. The checkboxes below are to identify that you have uploaded the other form of Bid Guaranty. DO NOT CHECK ALL BOXES. Refer to Section 2.10.1 of the Instructions to Bidders.

Submission of Bidder's Qualifications and EDGE Affidavit

The Bidder is encouraged to submit background information with its Bid using Document 00 45 13 - "Bidder's Qualifications" and Document 00 45 39 - "EDGE Affidavit" with the EDGE-certified Business(es) the Bidder proposes to use on the Project (forms provided for the Bidder's convenience in the block above). If the Bidder does not submit the Bidder's Qualifications form and/or the EDGE Affidavit form and related information attached to the electronic Bid Form, the Bidder shall provide it within 3 days of request. Refer to Sections 2.10.3 and 3.5.4 of the Instructions to Bidders.

Required Bid Guaranty Upload

Name	Omission Terms
Document 00 43 13 - Bid Security Form Upload a scan of the fully executed Bid Security Form AND submit the original document to th…	Bidder submitted a Cashier's Check below
Power of Attorney Upload a scan of the fully executed Power of Attorney AND submit the original document to th…	Bidder submitted a Cashier's Check below OR included with the Bid Security Form above
Cashier's Check for 10% of the Bid Upload a scan of the Cashier's Check AND submit the original check to the Contracting Autho…	Bidder submitted the Bid Security Form AND Power of Attorney above

3 Required Documents

Bidder's Qualifications and EDGE Affidavit Upload

Name	Omission Terms
Document 00 45 13 - Bidder's Qualifications Upload fully completed form and attachments	Must be submitted within 3 days of request
Document 00 45 39 - Edge Affidavit Upload a completed form for each EDGE Business	Must be submitted within 3 days of request

2 Required Documents

Bidder Signatory and Information

Bidder Signatory

Name of Bidder's Authorized Signatory:*

Title of Authorized Signatory:*

All Bidders complete all information in this form. Duplicate and complete the block below for each Joint Venturer (if applicable):

Bidder Information:

Business Name:*

Business Mailing Address, City, State, Zip:*

Telephone Number:*

Facsimile Number:

Email Address:*

Federal Tax ID Number:*

State of Incorporation (if applicable):

Contact person for Contract processing:*	**Date enrolled in an OBWC-approved DFSP (month/date/year):**
President's or Chief Executive Officer's Name:*	**President's or Chief Executive Officer's Title:***

END OF DOCUMENT

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infotech

Document 00 10 00 - Solicitation (General Contracting / Electronic Bid)
State of Ohio Standard Requirements for Public Facility Construction

Electronic bids will be received by:

Ohio Facilities Construction Commission
https://bidexpress.com

for the following Project:

Project No. WSU-231035
Lake Campus Workforce Development Project
Wright State University
Celina, Mercer County

in accordance with the Contract Documents prepared by:

Fanning/Howey Associates, Inc.
128 West Market Street
Celina, OH 45822
Phone No. (419)586-7771
FAX No. (419)586-2141
Rodney D. Wiford
rwiford@fhai.com
https://fhai.com

In compliance with Section 153.08 of the Ohio Revised Code and Section 153:1-8-01 of the Ohio Administrative Code, Bids for this Project are being received, opened, and published through electronic means using the State's electronic bidding service.

To access this Project through the electronic bidding service, you must first register at https://bidexpress.com by clicking on the "REGISTER FOR FREE" button and following the instructions. In order to bid, you must create and enable a digital ID within the service. This process requires the submission of notarized paperwork and may take up to five business days to complete. There are no fees to register, create and enable a digital ID, or to download bid documents. There is a small expense on a monthly or per bid basis to submit a bid. The electronic bidding service offers customer support that may be reached at 888.352.2439 or via email at support@bidexpress.com.

Bidders may submit requests for consideration of a proposed Substitution for a specified product, equipment, or service to the Architect/Engineer ("A/E") no later than 10 days prior to the bid opening. Additional products, equipment, and services may be accepted as approved Substitutions only by written Addendum.

From time to time, the Commission issues new editions of the "State of Ohio Standard Requirements for Public Facility Construction" and may issue interim changes. Bidders must submit Bids that comply with the version of the Standard Requirements included in the Contract Documents.

Prevailing Wage rates and Equal Employment Opportunity requirements are applicable to this Project.

This Project is subject to the State of Ohio's Encouraging Diversity, Growth, and Equity ("EDGE") Business Development Program. A Bidder is required to submit with its Bid and with its Bidder's Qualifications form, certain information about the certified EDGE Business Enterprise(s) participating on the Project with the Bidder. Refer to **Section 6.1.10** of the **Instructions to Bidders**.

The EDGE Participation Goal for the Project is **«5.0» percent**.

The percentage is determined by the contracted value of goods, services, materials, and labor that are provided by EDGE-certified business(es). The participation is calculated on the total amount of each awarded contract. For more information about EDGE, contact the Business Certification Compliance Manager at Stacy.Cornett@development.ohio.gov, or at 77 South High Street, 28th Floor, Columbus, Ohio 43215; or by telephone at (614) 728-0088.

The Bidder may be subject to a Pre-Award Affirmative Action Compliance Review in accordance with Section 123:2-5-01 of the Ohio Administrative Code including a review of the Bidder's employment records and an on-site review.

The Bidder must indicate on the electronic Bid Form, the locations where its services will be performed in the spaces provided or by attachment in accordance with the requirements of Executive Order 2019-12D related to providing services only within the United States and the requirements of Executive Order 2022-02D prohibiting purchases from or investment in any Russian institution or company. Failure to do so may cause the Bid to be rejected as non-responsive.

DOMESTIC STEEL USE REQUIREMENTS AS SPECIFIED IN OHIO REVISED CODE SECTION 153.011 APPLY TO THIS PROJECT. COPIES OF OHIO REVISED CODE SECTION 153.011 CAN BE OBTAINED FROM ANY OF THE OFFICES OF THE OHIO FACILITIES CONSTRUCTION COMMISSION.

Bidders are encouraged to be enrolled in and to be in good standing in a Drug-Free Safety Program ("DFSP") approved by the Ohio Bureau of Workers' Compensation ("OBWC") prior to submitting a Bid and provide, on the Electronic Bid Form with its Bid, certain information relative to their enrollment in such a program; and, if awarded a Contract, shall comply with other DFSP criteria described in **Section 1.6** of the **General Conditions**.

Electronic bids will be received for:

Trade	Estimate
General Contract	$4,447,383.00
Alternate No. 1 – Room Nos. 108A and 108B	68,000.00
Alternate No. 2 – Temperature Control Systems	66,000.00
Alternate No. 3 – West Entrance Canopy	9,700.00
Alternate No. 4 – Screening Mechanical Yard	10,000.00
Alternate No. 5 – Refinish Room	25,000.00
Alternate No. 6 – Landscaping	16,000.00

until November 4, 2026, at 2:00 pm., when all Bids will be electronically opened. Bid tabulations will be posted no later than 5:00 p.m. on the day Bids are opened.

All Bidders are strongly encouraged to attend the Pre-Bid Meeting on October 21, 2026, at 10:30 am. at the following location: Wright State University – Lake Campus, 7600 Lake Campus Drive, Celina, Ohio 45822.

The Contractor is responsible for scheduling the Project, coordinating the Subcontractors, and providing other services identified in the Contract Documents.

The Contract Documents may be downloaded as electronic PDF files from the State's electronic bidding service at https://bidexpress.com at no charge.

END OF DOCUMENT

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ARTICLE 1 - GENERAL INSTRUCTIONS

1.1 Applicable Law and Forum

1.1.1 The rights of any Bidder or any party to a subsequent Contract shall be governed by the laws of the state of Ohio and only Ohio courts shall have jurisdiction over any action or proceeding related to the Bid or any subsequent Contract. The Bidder irrevocably consents to such jurisdiction.

1.2 Project Scheduling and Coordination

1.2.1 When the Contract Documents refer to a period of time by a number of days, it excludes the first day and includes the last day of the period. If the last day of the period falls on a Saturday, Sunday, or a legal holiday, that day shall be omitted and the period shall end on the next day which is not a Saturday, Sunday, or legal holiday.

1.2.2 The time for completion of the Project indicated on the electronic **Bid Form** is the time for Substantial Completion of all Work applicable to the Bidder.

1.2.3 The State may assign all or any portion of its interest in a Contract with one or more of the successful Bidders to another successful Bidder as an agreed condition for an award of the Contract for the respective Bid. The assignment may include, without limitation, the duty to schedule, coordinate, and administer the Contract.

1.2.4 The Contractor is responsible for scheduling the Project, coordinating the Subcontractors, and providing other services identified in the Contract Documents.

1.2.5 By submitting its Bid, the Bidder indicates its understanding that the Contract Sum, based on its Bid and as amended by Change Orders, includes all costs that the Contracting Authority owes the Bidder.

1.3 Written Notice

1.3.1 Notice under the Contract Documents shall be validly given if:

1.3.1.1 delivered personally to a member of the organization for whom the notice is intended;

1.3.1.2 delivered, or sent by registered or certified mail, to the last known business address of the organization; or

1.3.1.3 sent by facsimile, email, or web-based project management software, provided the original signed document is delivered within 3 business days after the date of the electronic transmission.

1.3.2 Notices provided to one Project Participant from another shall be simultaneously copied to the prospective Bidders, the Owner, the Contracting Authority, and the A/E.

1.4 Use of the State's Electronic Bidding Software

1.4.1 The Bidder shall use the State's Electronic Bidding Software to submit its Bid for this Project. Paper Bids will not be accepted.

1.4.2 Bidders, Subcontractors, and Material Suppliers may download the Contract Documents as PDF files from the State's Electronic Bidding Software at no charge by registering and associating with a company at https://bidexpress.com.

1.4.3 Bidders are encouraged to create and obtain approval of their Digital ID well in advance of the bid deadline. Approval may take up to seven business days.

1.4.4 Bidders are also encouraged to click the "Select for Bidding" link on the electronic **Bid Form** to be listed on the electronic Plan Holder's list and submit payment to receive notifications regarding Addenda and other announcements.

1.4.5 Subcontractors and Material Suppliers may view the electronic Plan Holder's list to determine potential Bidders.

1.4.6 Bidders, Subcontractors, and Material Suppliers are encouraged to attend a contractor webinar or contact the vendor's help desk through the means identified at https://bidexpress.com to increase their knowledge of using the State's Electronic Bidding Software.

ARTICLE 2 - BIDDING PROCEDURES

2.1 Examination of Contract Documents and the Site

2.1.1 Before submitting a Bid, the Bidder shall examine all Contract Documents, including, but not limited to, the Drawings, Specifications, and Addenda for all divisions of Work for the Project, noting in particular all requirements that may affect its Work in any way.

2.1.2 The Bidder's failure to become acquainted with the extent and nature of Work required to complete any portion of the Work in conformity with the requirements of the Contract Documents, shall not be a basis for additional compensation.

2.1.3 Before submitting a Bid, the Bidder should not only examine and evaluate the Site and related Project conditions where the Work will be performed, but shall also consider when the Work will be performed including, but not limited to, the following:

2.1.3.1 the condition, layout, and nature of the Site and surrounding area;

2.1.3.2 the availability and cost of labor;

2.1.3.3 the availability and cost of materials, supplies, and equipment;

2.1.3.4 the cost of temporary utilities required in the Bid;

2.1.3.5 the cost of any permit or license required by a local or regional authority having jurisdiction over the Project;

2.1.3.6 the usual weather conditions of the Project location;

2.1.3.7 conditions bearing upon transportation, disposal, handling, and storage of equipment, materials, and waste; and

2.1.3.8 subsurface and concealed physical conditions and related information provided in the Contract Documents.

2.2 Pre-Bid Meeting

2.2.1 The Bidder is encouraged to attend the pre-bid meeting, where the A/E, the Contracting Authority, and the Owner will receive questions regarding the Contract Documents. If not given in **Document 00 10 00** - **Solicitation**, the A/E shall issue notice of the time and place of any pre-bid meeting to each registered Plan Holder.

2.2.2 The A/E shall prepare minutes of the pre-bid meeting for the Project record. If questions raised by the prospective Bidders require changes to, or clarifications of, the Contract Documents, the A/E shall issue the changes by written Addendum, along with a list of pre-bid meeting attendees.

2.2.3 Additional compensation shall not be based upon the Bidder's failure to attend the pre-bid meeting, which results in the Bidder's incomplete knowledge and familiarity of the Project requirements.

2.3 Request for Interpretation

2.3.1 If the Bidder finds any perceived ambiguity, conflict, error, omission, or discrepancy within the Contract Documents, including the Drawings, Specifications, and Addenda, or between any of the Contract Documents and Applicable Law, the Bidder shall submit a written Request for Interpretation ("RFI") to the A/E for an interpretation or clarification.

2.3.1.1 The Bidder is responsible for prompt delivery of the RFI.

2.3.1.2 The A/E shall respond to RFIs received more than 7 days before the bid opening.

2.3.2 The A/E shall issue Addenda in response to RFIs that modify or clarify the Contract Documents. Any Addenda issued within 72 hours before any bid opening (excluding Saturdays, Sundays, and legal holidays) shall extend the bid opening date by 7 days pursuant to **Section 3.3.1**.

2.3.2.1 The Addenda may be delivered via the State's Electronic Bidding Software, e-mail, posted to a web or FTP site, or otherwise furnished to each registered Plan Holder.

2.3.3 Any interpretation or clarification of the Contract Documents made by any Person other than the A/E, in any manner other than a written Addendum, shall not be binding, and the Bidder shall not rely upon the interpretation or clarification.

2.3.4 The successful Bidder shall not be compensated for a claim alleging insufficient data, incomplete, ambiguous, conflicting, or erroneous Contract Documents or proposed Contract Documents, or assumed conditions regarding the nature, extent, or character of the Work, if the Bidder did not submit a related RFI prior to the bid opening.

2.4 Basis of Design and Acceptable Components

2.4.1 The Contract Documents may list components produced by specific manufacturers to denote kind, quality, or performance requirements.

2.4.2 The component listed first is the Basis of Design Component.

2.4.3 Other listed components are Acceptable Components.

2.4.3.1 If the Bidder includes an Acceptable Component in its Bid, the Bidder is responsible for the costs of coordination and modification required.

2.5 Substitutions Prior to Bid Opening

2.5.1 If the Bidder proposes to use an article, device, material, equipment, form of construction, fixture, or item other than the Basis of Design or Acceptable Components named in the Specifications, the Bidder shall certify that the proposed item is equal in quality and all aspects of performance and appearance, to the item specified.

2.5.1.1 If approval of a Substitution requires changes to the Contract Documents or affects the work of other trades, the Bidder is responsible for the additional costs, including, but not limited to, changes to the design by the A/E.

2.5.2 The Bidder shall submit its request for Substitution to the A/E no later than 10 days prior to the bid opening, which must include:

2.5.2.1 the name and complete description of the proposed Substitution, including Drawings, performance and test data, and other information necessary for a complete evaluation; and

2.5.2.2 a statement setting forth any changes that the Proposed Substitution will require in the Contract Documents or the Project.

2.5.3 If the A/E approves the Proposed Substitution, the A/E shall issue an Addendum.

2.5.4 If the A/E does not approve the Proposed Substitution, the A/E shall inform the Bidder of its decision, which is final. The A/E may reject a proposed Substitution because the Bidder failed to provide sufficient information to enable the A/E to completely evaluate the Proposed Substitution without causing a delay in the bid deadline.

2.5.5 Proposed Substitutions received by the A/E less than 10 days prior to the bid deadline shall not be considered.

2.6 Electronic Bid Form

2.6.1 Each Bid shall be submitted on the electronic **Bid Form** through the State's Electronic Bidding Software.

2.6.1.1 All sections of the electronic **Bid Form**, including a completed "Bidder Affirmation and Disclosure" section acknowledging that the Bidder affirms, understands, and will abide by the requirements of Executive Order 2019-12D related to providing services only within the United States and Executive Order 2022-02D prohibiting purchases from or investment in any Russian institution or company, and a completed "Commitment to Participate in the EDGE Business Assistance Program" page, shall be submitted with the Bid. Failure to do so may cause the Bid to be rejected as non-responsive.

.1 If the names, locations, and service locations of Subcontractors are not known at the time of the Bid deadline, the Bidder must provide the information requested with its **Subcontractor and Material Supplier Declaration**.

2.6.1.2 Unless the Bidder withdraws the Bid as provided in **Article 4**, the Bidder is required to comply with all requirements of the Contract Documents, regardless of whether the Bidder had actual knowledge of the requirements and regardless of any statement or omission made by the Bidder that might indicate a contrary intention.

2.6.2 The Bidder shall fill in all relevant spaces on the electronic **Bid Form**. The State's Electronic Bidding Software will identify any incomplete required fields.

2.6.3 If the Bidder is a corporation, partnership, or sole proprietorship, an officer, partner or principal of the Bidder shall enter the legal name of the Bidder in the space provided on the electronic **Bid Form**. If the Bidder is a joint venture, an officer, partner or principal, as applicable, of each member of the joint venture shall enter the legal name of the applicable member in the space provided.

2.7 Allowances

2.7.1 If Allowances are provided on the electronic **Bid Form**, the amount of each Allowance shall be included in the Base Bid amount. Allowances shall be used solely for the purpose of determining the adjustment to the Contract Sum for the difference between the amount of the Allowance and the actual cost of the related Work provided. Allowances shall not include the Contractor's Fee.

2.8 Unit Prices

2.8.1 If Unit Prices are requested on the electronic **Bid Form**, the amount of the scheduled quantities shall be included in the Base Bid amount. Unit prices shall be used solely for the purpose of determining the adjustment to the Contract Sum for the difference between the estimated quantities on the electronic **Bid Form** and the actual quantities provided.

2.8.2 Unit Prices shall include all materials, equipment, labor, delivery, installation, and any other cost or expense, in connection with, or incidental to, the performance of that portion of the Work. Unit Prices shall not include the Contractor's Fee on account of the associated Unit Price Work. The Bidder shall submit Unit Prices for all items listed.

2.9 Alternates

2.9.1 If an Alternate is listed on the electronic **Bid Form**, the Bidder shall fill in the applicable space with a positive or negative bid amount as applicable. The Contracting Authority reserves the right to accept or reject any or all bid amounts for Alternates, in whole or in part, and in any order.

2.9.1.1 If no change in the bid amount is required, indicate "$0."

2.9.1.2 Failure to make an entry on any Alternate shall cause the Bid to be rejected as non-responsive if that Alternate is selected.

2.9.1.3 Failure to indicate a negative number will indicate the Bidder's intent to increase the Base Bid by the amount entered in the applicable space.

2.9.1.4 If an Alternate is not selected, an entry as listed in **Section 2.9.1.2** on that Alternate shall not, by itself, render a Bid non-responsive.

2.10 Submittals with Electronic Bid Form

2.10.1 The Contracting Authority shall reject a Bid as non-responsive if the Bidder fails to submit the following with the Bid:

2.10.1.1 An electronic facsimile of the Bid Guaranty as provided in **Article 5**, meeting the requirements of Ohio Revised Code ("ORC") Sections 153.54 and 153.571.

2.10.1.2 The original unaltered Bid Guaranty shall be delivered to the Contracting Authority within 3 business days after the public bid opening as provided in Ohio Administrative Code ("OAC") Section 153:1-8-01(H).

2.10.2 If the apparent low Bidder does not submit a valid Power of Attorney of the agent signing for the Surety with its Bid, the Contracting Authority shall direct the apparent low Bidder to deliver a valid and appropriate Power of Attorney to the Contracting Authority within a period determined by the Contracting Authority. The Contracting Authority shall not enter into a Contract without a valid Power of Attorney.

2.10.3 The Bidder is encouraged to submit background information with its Bid using the **Bidder's Qualifications** form and including, but not limited to, the information listed in this **Section 2.10**. If the apparent low Bidder does not submit the **Bidder's Qualifications** form and related information attached to the electronic **Bid Form**, the Bidder shall provide it upon request in accordance with **Section 3.5.4**, including, but not limited to:

2.10.3.1 the overall experience of the Bidder, including number of years in business under present and former business names;

2.10.3.2 a complete listing of all the Bidder's ongoing construction projects and a listing of construction projects which are similar in cost and type to the Project completed by the Bidder in the last 5 years. Include information of

the scope of work and value of each contract, a description of Encouraging Diversity Growth and Equity ("EDGE") participation and performance, and a project name/contact Person/address/phone number for the owner and the architect or engineer for each project;

2.10.3.3 a complete listing of Prevailing Wage, EPA, OSHA, or other regulatory entity issues or violations in the last 5 years;

2.10.3.4 a complete listing of judgments, claims, arbitration proceedings or suits pending or outstanding in the last 5 years;

2.10.3.5 a complete listing of Substance Use Prevention and Recovery ("SUPR") violations in the last 5 years;

2.10.3.6 upon request of the Contracting Authority, the apparent low Bidder shall submit the following information, which is not a public record under ORC Section 149.43; and shall remain confidential, except under proper order of a court:

.1 an annual financial statement prepared within the 12 months prior to the bid opening by an independent licensed accounting firm; and the name, address, contact Person, and phone number of the bank normally used by the Bidder for its primary banking**;** or

.2 a financial report generated within 30 days prior to the bid opening from Standard and Poor, Dun and Bradstreet or a similar company acceptable to the Contracting Authority documenting the financial condition of the Bidder; and the name, address, contact Person, and phone number of the bank normally used by the Bidder for its primary banking.

2.10.3.7 a description of the Bidder's relevant facilities and major equipment, whether leased or owned;

2.10.3.8 a description of the management experience of the Bidder's project manager(s) and superintendent(s) and a comprehensive resume for each;

2.10.3.9 a description of the EDGE-certified Business(es) the Bidder proposes as Subcontractors for this Project by attaching a fully completed **EDGE Affidavit** form for each EDGE-certified Business;

2.10.3.10 to support a Bond, a current and signed Certificate of Compliance issued by the Ohio Department of Insurance, showing the Surety is licensed to do business as a surety in Ohio;

2.10.3.11 a current Ohio Workers' Compensation Certificate;

2.10.3.12 if the Bidder is a foreign corporation not incorporated under the laws of Ohio, a Certificate of Good Standing from the Ohio Secretary of State; or, if the Bidder is a foreign person or partnership, evidence that the Bidder filed, with the Ohio Secretary of State, a Power of Attorney designating the Ohio Secretary of State as the Bidder's agent for the purpose of accepting service of summons in any action brought under ORC Section 153.05 or under ORC Sections 4123.01 to 4123.94, inclusive;

2.10.3.13 evidence that the Bidder is enrolled in, and in good standing in, a SUPR program approved by the Ohio Bureau of Workers' Compensation ("OBWC"); and

2.10.3.14 any other data or information which the A/E may request concerning the responsibility of the Bidder, including a complete list of major Subcontractors with an estimated contract value of $200,000 or more, which the Bidder proposes to employ on the Project.

2.11 Changes in the Bid Amount

2.11.1 Any change to a previously submitted Bid shall be resubmitted through the State's Electronic Bidding Software prior to the deadline for submission of Bids.

ARTICLE 3 - BID OPENING AND EVALUATION

3.1 Delivery of Bid

3.1.1 The Bidder shall submit its Bid to the Contracting Authority prior to the time of the bid deadline.

3.1.2 Bids that are submitted after the time of the bid deadline shall not be considered.

3.2 Bid Opening

3.2.1 Electronic Bids shall be received until the time stated when all Bids shall be electronically opened and the Bid tabulation made public by posting on the State's Electronic Bidding Software.

3.2.2 The posting of Bid tabulations is for informational purposes only and is not to be construed as an acceptance or rejection of any Bid submitted.

3.2.3 The contents of the electronic **Bid Form** and its attachments are public records and shall be available for inspection, upon request, at any time after the bid deadline, except for any information that is not defined as a public record under Ohio law.

3.3 Bid Deadline Extension

3.3.1 If an Addendum is issued within 72 hours prior to the published time for the bid deadline, excluding Saturdays, Sundays and legal holidays, the bid deadline shall be extended 7 days. If the Contracting Authority approves, the bid deadline may be extended for more than 7 days, and consideration for additional advertising may be recommended.

3.3.2 As part of issuing any Addendum earlier than 72 hours prior to the published time for the bid deadline, excluding Saturdays, Sundays and legal holidays, only the Contracting Authority may approve a revised bid deadline or additional advertising.

3.4 Bid Evaluation Criteria

3.4.1 The Contracting Authority reserves the right to accept or reject any or all Bids, in whole or in part, and reserves the right to award the Contract to any remaining Bidder the Contracting Authority determines, in its sole discretion, to have submitted the lowest responsive and responsible Bid.

3.4.2 The Contracting Authority reserves the right to accept or reject any or all Alternates. Alternates may be accepted or rejected in any order.

3.4.3 If any Bidder has engaged in collusive bidding, the Contracting Authority shall reject that Bidder's Bid as non-responsible for the Contract. A collusive bidder may also be debarred from future State Contracts.

3.4.4 The Contracting Authority reserves the right to waive, or to allow any Bidder a reasonable opportunity to cure a minor irregularity or technical deficiency in a Bid, provided the irregularity or deficiency does not affect the bid amount, or otherwise give the Bidder a competitive advantage. Noncompliance with any material requirements of the Contract Documents shall cause a Bid to be rejected as non-responsive.

3.4.5 If, in the opinion of the Owner, the award of the Contract to the lowest Bidder is not in the best interest of the State, with the written consent of the Contracting Authority, the Owner may accept, in its discretion, another Bid so opened, or the Contracting Authority may reject all Bids and solicit for other Bids. The solicitation shall be for the period, in the form, and in the manner directed by the Contracting Authority.

3.5 Bid Evaluation Procedure

3.5.1 The Contract shall be awarded to the lowest responsive and responsible Bidder as determined in the discretion of the Contracting Authority, or all Bids may be rejected in accordance with Applicable Law.

3.5.1.1 In determining which Bid is the lowest, the Contracting Authority shall consider the Base Bid and the bid amounts for any Alternate, or Alternates, which the Owner decides, in its sole discretion, to accept.

3.5.1.2 The total of the bid amounts for the accepted Alternate(s) shall be added to, or deducted from, the Base Bid, as applicable, for determining the lowest Bidder.

3.5.1.3 If two Bidders submit the same bid amount and both are determined to be responsive and responsible, the Contracting Authority may select one Bidder by the flip of a coin, which shall be conducted in the presence of both Bidders and shall be final.

.1 If one of the Bidders refuses to participate in, or fails to be present at, the flip of a coin, the remaining Bidder shall be selected.

3.5.2 A Bidder for a Contract shall be considered responsive if the Bidder's Bid responds to the Contract Documents in all material respects and contains no irregularities or deviations from the Contract Documents that would affect the amount of the Bid or otherwise give the Bidder a competitive advantage.

3.5.2.1 A Bid shall be rejected as non-responsive if the Bid contains a Bid Guaranty executed by a Surety not licensed in Ohio or a Bid Guaranty that is otherwise determined to be insufficient by the Contracting Authority.

3.5.2.2 If the lowest Bidder is non-responsive, the Bidder shall be notified according to **Section 3.6**.

3.5.3 In determining whether a Bidder is responsible, factors to be considered include, without limitation:

3.5.3.1 preferences required by law, where applicable;

3.5.3.2 the experience of the Bidder;

3.5.3.3 the financial condition of the Bidder;

3.5.3.4 the conduct and performance of the Bidder on previous Contracts, including compliance with Equal Employment Opportunity in the Construction Industry Administrative Rules, OSHA and Prevailing Wage laws, and demonstration of good faith effort to participate in the EDGE Business Development program, or actual participation in the EDGE Business Development program, or both, as indicated in the ORC and the Ohio Administrative Code;

3.5.3.5 the facilities of the Bidder;

3.5.3.6 the management skills of the Bidder, including the capability of the Bidder to construct and manage the entire Project, including but not limited to the plumbing, fire protection, heating, ventilating and air conditioning, and electrical branches or classes of the Work; and

3.5.3.7 the Bidder's ability to execute the Contract properly, including past performance of the Bidder and the Subcontractors that the Bidder proposes to use on the Project.

3.5.4 The A/E shall obtain from the lowest responsive Bidder any information the Contracting Authority determines appropriate to consideration of factors showing responsibility. If the lowest responsive Bidder is responsible, the Contract shall be awarded to that Bidder, unless all Bids are rejected. The Bidder shall provide all requested information within 3 days of a request from the A/E**,** or a longer period, if the Contracting Authority consents in writing.

3.5.5 If the lowest responsive Bidder is not responsible, the Contracting Authority shall evaluate the next lowest Bidder according to the procedures set forth in this **Section 3.5** until the Contract is awarded, all Bids are rejected, or all responsive Bidders are determined to be not responsible.

3.6 Rejection of Bid

3.6.1 If the lowest Bidder is not responsive or responsible, the Contracting Authority shall reject the Bid and notify the Bidder in writing of the finding and the reasons for the finding. The notice shall be given by email, or by certified mail if no email address is available.

3.6.2 Ten Percent Rule.

3.6.2.1 If the lowest responsive and responsible Bid for the Contract, including the Base Bid and accepted Alternates if any, exceeds an amount 10 percent greater than the published Estimated Construction Cost for the Contract, the Contracting Authority shall reject all Bids.

3.6.3 A Bidder notified in accordance with **Section 3.6.1** may object to its rejection by filing a written protest, which must be received by the Contracting Authority within 5 days of the notification provided pursuant to **Section 3.6.1**.

3.6.4 Upon receipt of a timely protest, the Contracting Authority shall meet with the protesting Bidder to hear its objections. ORC Chapter 119 administrative hearing requirements are not applicable to the bid protest meeting**.**

3.6.4.1 No Contract award shall become final until after the Contracting Authority has met with all Bidders who have timely filed protests and the award of the Contract is affirmed by the Contracting Authority.

3.6.4.2 If all protests are rejected, the Contract shall be awarded to the lowest responsive and responsible Bidder, or all Bids shall be rejected.

3.7 Notice of Intent to Award

3.7.1 The Contracting Authority shall notify the apparent successful Bidder that upon satisfactory compliance with all conditions precedent for execution of the Contract, within the time specified, the Bidder shall be awarded the Contract.

3.7.2 The Contracting Authority reserves the right to rescind any Notice of Intent to Award if the Contracting Authority determines it issued the Notice of Intent to Award in error, or if the conditions precedent for execution of Contract set forth in **Article 6** are not met.

ARTICLE 4 - WITHDRAWAL OF BID

4.1 Withdrawal prior to Bid Opening

4.1.1 A Bidder may withdraw a Bid after submitting the Bid through the State's Electronic Bidding Software, provided the Bidder submits its request through the State's Electronic Bidding Software prior to the bid deadline.

4.2 Withdrawal after Bid Opening

4.2.1 The Bid shall remain valid and open for acceptance for a period of 60 days after the bid opening; provided, however, a Bidder may withdraw a Bid from consideration after the bid opening if the bid amount was substantially lower than the amounts of other Bids, providing the Bid was submitted in good faith, and the reason for the bid amount being substantially lower was a clerical mistake, as opposed to a judgment mistake, and was actually due to an unintentional and substantial arithmetic error or an unintentional omission of a substantial quantity of Work, labor, or material made directly in the compilation of the bid amount.

4.2.1.1 Notice of a request to withdraw a Bid shall be made in writing filed with the Contracting Authority within 2 business days after the bid opening. The Contracting Authority reserves the right to request the Bidder to submit evidence substantiating the Bidder's request to withdraw the Bid.

4.2.1.2 No Bid may be withdrawn under **Section 4.2.1** which would result in awarding a Contract involving the same item on another Bid to the same Bidder.

4.2.2 If a Bidder withdraws its Bid under **Section 4.2.1**, the Contracting Authority may award the Contract to the next lowest responsive and responsible Bidder, or reject all Bids and advertise for other Bids. In the event the Contracting Authority advertises for other Bids, the withdrawing Bidder shall pay the costs, in connection with the re-bidding, of printing new Contract Documents, required advertising, and printing and mailing of notices to prospective Bidders, if the Contracting Authority finds that these costs would not have been incurred but for the withdrawal.

4.2.3 A Bidder may withdraw the Bidder's Bid at any time after the 60-day period described in **Section 4.2.1** by giving written notice to the Contracting Authority.

4.3 Refusal to Accept Withdrawal

4.3.1 If the Contracting Authority contests the right of a Bidder to withdraw a Bid pursuant to **Section 4.2.1**, a hearing shall be held within 10 days after the bid opening and the Contracting Authority shall issue an order allowing or denying the claim of this right within 5 days after the hearing is concluded. The Contracting Authority shall give the withdrawing Bidder timely notice of the time and place of the hearing.

4.3.1.1 The Contracting Authority shall make a stenographic record of all testimony, other evidence, and rulings on the admissibility of evidence presented at the hearing. The Bidder shall pay the costs of the hearing.

4.3.1.2 Pursuant to ORC Section 119.12, the Bidder may appeal the order of the Contracting Authority required by **Section 4.3.1**.

4.4 Refusal to Perform

4.4.1 In the event the Contracting Authority denies the request for withdrawal and the Bidder refuses to perform the Contract, the Contracting Authority may reject all Bids or award the Contract to the next lowest responsive and responsible Bidder.

4.5 Effect of Withdrawal

4.5.1 A Bidder, who is permitted to withdraw a Bid under **Section 4.2.1**, shall not supply material or labor to, or perform a subcontract or other work for, the Person to whom the Contract is awarded. The Bidder shall not otherwise benefit, directly or indirectly, from the performance of the Project for which the withdrawn Bid was submitted without the Contracting Authority's prior written consent.

ARTICLE 5 - BID GUARANTY AND BOND

5.1 Bid Guaranty

5.1.1 The Bidder shall submit a Bid Guaranty with the Bidder's Bid, payable to the Contracting Authority, in the form of any of the following:

5.1.1.1 the signed **Document 00 43 13** - **Bid Security Form** contained in the Contract Documents for the amount of the Base Bid plus all additive Alternates; or

5.1.1.2 a certified check, cashier's check, or letter of credit, for 10 percent of the Base Bid, plus all additive Alternates – a letter of credit shall expressly provide that it is revocable only by the Contracting Authority; or

5.1.1.3 an electronic verification through an electronic verification and security system described in ORC section 153.08.

5.1.2 The Bid Guaranty shall be in form and substance satisfactory to the Contracting Authority and shall serve as an assurance that upon acceptance of the Bid, the Bidder shall comply with all conditions precedent for Contract execution, within the time specified by the Contracting Authority.

5.1.3 If the blank line on the **Bid Security Form** is not filled in, the penal sum shall be the full amount of the Base Bid plus all additive Alternates. If the blank line is filled in, the amount shall not be less than the full amount of the Base Bid plus all additive Alternates, stated in dollars and cents. A percentage is not acceptable. In the event the blank line is filled in for an amount less than the full amount of the Base Bid plus all additive alternates, the Bid shall be rejected as non-responsive.

5.1.4 An authorized agent must sign the **Bid Security Form**, and the Bidder shall provide a Power of Attorney from the Surety. A Surety authorized by the Ohio Department of Insurance to transact business in Ohio must issue the **Bid Security Form**.

5.1.5 The requirements of ORC Section 3901.86 may be applicable requiring an Ohio resident agent countersign the **Bid Security Form**. The Bidder shall determine the applicability of this provision.

5.1.6 Bid Guaranties in the form of a certified check, cashier's check, or letter of credit shall be returned to unsuccessful Bidders 60 days after the bid opening. Bid Guaranties in the form of a certified check, cashier's check, or letter of credit shall be returned to the successful Bidder upon providing **Document 00 61 13** - **Performance and Payment Bond Form** from a Surety satisfactory to the Contracting Authority.

5.2 Forfeiture of Bid Guaranty

5.2.1 If for any reason, other than as authorized by **Section 4.2.1** or **Section 5.3**, the Bidder fails to execute the Agreement, and the Contracting Authority awards the Contract to another Bidder, which the Contracting Authority determines is the lowest responsive and responsible Bidder:

5.2.1.1 The Bidder who failed to execute the Agreement is liable to the State for the difference between its Bid and the Bid of the next lowest responsive and responsible Bidder, or for a penal sum not to exceed ten percent of the bid amount, whichever is less.

5.2.2 If the Contracting Authority then awards a Contract to another Bidder, which the Contracting Authority determines is the lowest responsive and responsible Bidder and that Bidder fails or refuses to execute the Agreement:

5.2.2.1 The liability of the lowest responsive and responsible Bidder shall be the difference between the bid amount of the lowest responsive and responsible Bidder and another Bidder which the Contracting Authority determines is the lowest responsive and responsible Bidder, except as provided in **Section 5.3**, but not in excess of the liability specified in **Section 4.2.2**.

5.2.2.2 The liability on account of an award to the lowest responsive and responsible Bidder beyond the third lowest responsive and responsible Bidder shall be determined in like manner**.**

5.2.3 If the Contracting Authority does not award the Contract to another Bidder under **Section 5.2.2**, but submits the Project for re-bidding:

5.2.3.1 The Bidder failing or refusing to execute the Agreement is liable to the State for a penal sum not to exceed 10 percent of the Bidder's bid amount or the costs in connection with the resubmission of printing new Contract Documents, required advertising, and printing and mailing notices to prospective Bidders, whichever is less, except as provided in **Section 5.3**.

5.3 Exception to Forfeiture

5.3.1 A Bidder for a Contract with the State costing less than $500,000 may withdraw its Bid from consideration if its Bid for another Contract with the State for less than $500,000 has already been accepted if:

5.3.1.1 the Bidder certifies in good faith that the total amount of its current contracts is less than $500,000; and

5.3.1.2 the Bidder's Surety certifies in good faith that the Bidder is unable to perform the subsequent Contract because such performance would exceed the Bidder's bonding capacity.

5.3.2 If a Bid is withdrawn pursuant to **Section 5.3.1**:

5.3.2.1 the Contracting Authority may award the Contract to another Bidder which the Contracting Authority determines is the lowest responsive and responsible Bidder or reject all Bids and submit the Project for re-bidding; and

5.3.2.2 neither the withdrawing Bidder nor the Bidder's Surety shall be liable for the difference between the Bidder's Bid and that of the next lowest responsive and responsible Bidder for a penal sum, or for the costs of printing new Contract Documents, required advertising, and printing and mailing notices to prospective Bidders.

5.4 Bond

5.4.1 Prior to signing the Agreement, the Bidder shall provide the Bond required by law in form and substance satisfactory to the Contracting Authority, and from a Surety licensed to do business in the state of Ohio and satisfactory to the Contracting Authority.

5.4.1.1 If the Bidder provided **Document 00 43 13** - **Bid Security Form**, described in **Section 5.1.1.1**, as its Bid Guaranty then that form shall be the Bond.

5.4.1.2 If the Bidder provided another form of Bid Guaranty, described in **Section 5.1.1.2**, then **Document 00 61 13** - **Performance and Payment Bond Form**, described in **Section 5.1.6**, shall be the Bond.

5.4.1.3 The Bidder shall not be required to provide both forms described above.

5.4.2 The Bond must be in the full amount of the Contract to indemnify the State against all direct and consequential damages suffered by failure of the Contractor to perform according to the provisions of the Contract and in accordance with the Plans, Specifications, details, and bills of material therefore and pay all lawful claims of Subcontractors, Material Suppliers, and laborers for labor performed or materials furnished in performing and completing the Contract.

ARTICLE 6 - CONTRACT AWARD AND EXECUTION

6.1 Conditions Precedent for Execution of Contract

6.1.1 The successful Bidder must submit the items in this **Section 6.1** to the Contracting Authority before executing the Agreement.

6.1.2 Bond, and to support the Bond, a Certificate of Compliance issued by the Ohio Department of Insurance, showing the Surety is licensed to do business in the state of Ohio.

6.1.3 Ohio Workers' Compensation Certificate

6.1.4 Certificate of Insurance (ACORD form is acceptable) and copy of additional insured or loss payee endorsement. The Contracting Authority reserves the right to request and receive a certified copy of the Contractor's insurance policies.

6.1.5 If a Bidder is a foreign corporation (e.g., not incorporated under the laws of Ohio) it must submit a Certificate of Good Standing from the Ohio Secretary of State showing the right of the Bidder to do business in the state of Ohio.

6.1.6 If a Bidder is an individual or partnership, nonresident of the State, it must submit a Power of Attorney designating the Ohio Secretary of State as the Bidder's agent for accepting service of summons in any action brought under ORC Section 153.05 or under ORC Sections 4123.01 to 4123.94, inclusive.

6.1.7 Evidence that the Bidder is enrolled in, and in good standing in, a SUPR program approved by the OBWC.

6.1.8 Required Notice of Unresolved Findings for Recovery.

6.1.8.1 By submitting its Bid, the Bidder warrants that it is not subject to an unresolved findings for recovery under ORC Section 9.24. ORC Section 9.24 prohibits the State from awarding a Contract to any Bidder against whom the Auditor of State has issued a finding for recovery if the finding for recovery is unresolved at the time of award. If the Contract is awarded to a Bidder subject to an unresolved finding for recovery under ORC Section 9.24, the Contract is void on its face and the Contractor shall immediately repay to the Owner any funds paid under the Contract.

6.1.9 EDGE Program – Supporting Documentation Required.

6.1.9.1 The Bidder shall provide evidence acceptable to the Contracting Authority of the Bidder’s participation in the EDGE Program by contracting with EDGE-certified Business(es) for the Project by submitting a fully completed EDGE Affidavit for each EDGE-certified Business, by requesting a waiver or partial waiver of the advertised EDGE Program participation goal for the Project on the Bidder’s company letterhead including full documentation of the Bidder’s good faith effort to contract with EDGE-certified Business(es) for this Project, or both.

6.1.10 If the Bidder is a joint venture, it must submit the executed agreement between the joint venturers describing the division of services/work and percentage of contract for each company, and a Power of Attorney which authorizes one or more individuals to bind the joint venture and each individual joint venturer to Contract Modifications.

6.2 Non-compliance with Conditions Precedent

6.2.1 The award of the Contract and execution of the Agreement require the Contractor to comply with:

6.2.1.1 all conditions precedent for execution of the Contract within 10 days of the date of the Notice of Intent to Award; and

6.2.1.2 the **Bidder's Qualifications** form, including a fully completed **EDGE Affidavit** for each EDGE-certified Business, not previously provided within 3 business days of receiving the Contracting Authority's request.

6.2.2 Non-compliance with the conditions precedent for execution of the Contract as stated in **Section 6.1** within the timelines stated in **Section 6.2.1** following the date of the Notice of Intent to Award shall be sufficient cause to permit the Contracting Authority to cancel the Notice of Intent to Award, for the Bidder's lack of responsibility and award the Contract to another Bidder, which the Contracting Authority determines is the lowest responsive and responsible Bidder; or the Contracting Authority may re-bid the Work at its sole discretion.

6.2.3 The Contracting Authority may extend the time for complying with the conditions precedent for execution of the Contract for good cause. The extension is not a waiver of the conditions precedent for execution of the Contract.

6.3 Time Limits

6.3.1 The Contracting Authority's failure to award the Contract and execute the Agreement-within 60 days of the bid opening invalidates the entire bid process and all Bids submitted, unless the time is extended by written consent of the apparent lowest responsive and responsible Bidder and the Contracting Authority.

6.3.1.1 If the Contracting Authority awards the Contract within 60 days of the bid opening, increases in material, labor, and subcontract costs shall be borne by the Bidder.

6.3.1.2 If failure to execute the Contract within 60 days of the bid opening is due to matters for which the State is solely responsible, the Contractor is entitled to a Change Order authorizing payment of verifiable increased costs in materials, labor, or subcontracts. This increase shall not exceed the difference in price between the successful Bidder and the price of the next lowest responsive and responsible Bidder.

6.3.1.3 If failure to execute the Contract within 60 days of the bid opening is due to matters for which the Contractor is responsible, the Contracting Authority shall not grant a request for increased costs.

6.4 Notice to Proceed

6.4.1 The Contracting Authority shall issue a Notice to Proceed to the Contractor, which establishes the date for commencement and the calendar days allocated for Substantial Completion of all Work. Within 10 days of the date of the Notice to Proceed, or other period as mutually agreed by the Contractor and the Contracting Authority, the Contractor shall furnish the following submittals to the A/E:

6.4.1.1 Schedule of Values;

6.4.1.2 preliminary schedule of Shop Drawings and other Submittals;

6.4.1.3 Subcontractor and Material Supplier Declaration form, with completed "Bidder Affirmation and Disclosure" forms acknowledging that the Contractor affirms, understands, and will abide by the requirements of Executive Order 2019-12D and Executive Order 2022-02D for Subcontractors that were not identified in the electronic **Bid Form**;

6.4.1.4 qualifications of proposed project manager(s) and superintendent(s) and a comprehensive resume of each; and

6.4.1.5 evidence that an authorization agreement for automatic deposit of state warrants has been submitted to Ohio Shared Services using the electronic funds transfer form provided on the Internet at http://supplier.ohio.gov.

6.5 Prevailing Wage Rates

6.5.1 The Bidder shall base its Bid upon the prevailing rates of wages as ascertained by the Ohio Department of Commerce, Wage and Hour Bureau for the Project as provided in ORC Sections 4115.03 through 4115.14. Refer to **Document 00 73 43** - **Wage Rate Requirements** for related information and the Project's prevailing rates of wages with an appropriate ratio of registered apprentices.

6.5.2 The Bidder shall not be entitled to an increase in the Contract Sum on account of an increase in prevailing wage rates, except as otherwise provided by Applicable Law. The Bidder is responsible for compliance of its Subcontractors with prevailing wage requirements.

6.5.3 Within 10 days of the date of the Notice to Proceed, the Contractor shall provide the Contracting Authority's Prevailing Wage Coordinator with a schedule of dates during the term of the Contract when the Contractor shall pay wages to its employees for the Project.

END OF DOCUMENT

DOCUMENT 00 21 15 - SUBSTITUTION REQUEST FORM
(During Bidding/Procurement Phase)

To: OhioBidQuestions@fhai.com Date: _____

Project Lake Campus Workforce Development Project

We hereby submit for your consideration the following product instead of the specified item(s) for the above project:

Section	Article/Paragraph (Page)	Specified Item
_____	_____	_____

Proposed
Substitution: _____ Model: _____

Manufacturer: _____ Phone: _____

Attach complete technical data including laboratory tests if applicable.

Include complete information changes to Drawings and/or Specifications which proposed substitution require for proper installation.

Fill in Blanks Below, use additional sheets if necessary:

A. Does the substitution affect dimensions shown on Drawings?

_____

B. Will the undersigned pay for changes to building design, including engineering and detailing costs caused by substitution, if any?

_____

C. What effect does substitution have on other trades? _____

_____

D. Differences between proposed substitution and specified item?

_____

E. Manufacturer's guarantees of proposed and specified items are:

_____Same _____Different (explain on attachment)

The undersigned certifies that the function, appearance and quality are equivalent or superior to the specified item.
Submitted By:

_____
Signature
_____
Firm _____
Address _____
_____
Telephone _____
Fax _____
Email _____

For Use by Design Consultant:

Accepted Accepted as Noted
Not Accepted Received too Late
PM _____
Specifier _____
Date _____
Remarks _____
Telephone _____

END OF DOCUMENT 00 21 15

DOCUMENT 00 31 00 - AVAILABLE PROJECT INFORMATION

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting (Bidding) Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidder's convenience and information. This Document and its attachments are not part of the Contract Documents.

B. Because subsurface conditions indicated by the soils borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the A/E, the A/E's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.

C. The Soils Exploration Report and Soil Boring Logs were prepared for the Owner by CTL Engineering, 102 Commerce Drive, P.O. Box 44, Wapakoneta, Ohio 45895, phone no. 419-738-1447 for use in design. The following Subsurface Investigation Report is not a part of the construction Contract Documents and is enclosed within this document for informational use only.

1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer.
2. The enclosed report and Log of Borings, and any interpolations of conditions between test borings is not a warrant or guarantee by the Owner or Architect/Engineer of subsurface conditions.
3. The Contractor should visit the site and acquaint himself with all existing conditions. Prior to bidding, bidders may make their own subsurface investigations to satisfy themselves as to the site and subsurface conditions, but such subsurface investigations shall be performed only under the time schedules and arrangements approved in advance by the Owner. Any additional information, needed by the Contractor, shall be obtained by the Contractor at no cost to the Owner.
4. Structural design has been based on the report and assumes that existing soils are clean and can be compacted and will achieve the densities specified in the earthwork section. It shall be the Contractor's responsibility to determine for himself existing Site and or soil conditions.

E. Roofing Installer's Warranty from Duro-Last.

END OF DOCUMENT 00 31 00

Document 00 31 01

Roofing Installer’s Warranty

(Document enclosed hereinafter)

DURO-LAST®

20-Year NDL Warranty

Warranty No. Q 1360385

I. TERMS and CONDITIONS

Duro-Last®, Inc., ("Duro-Last") grants this No-Dollar Limit ("NDL") Warranty to the owner of a building ("Owner") containing a **Duro-Last Roofing System** ("**Duro-Last System**") installed by a Duro-Last Authorized Dealer/Contractor ("Contractor"), subject to the terms and conditions and limitations contained herein.

Duro-Last's obligation during the 1st through 20th year shall be to repair any leak in the Duro-Last System caused by any defect in a component of the Duro-Last System or by the workmanship of the Contractor, but only as the workmanship relates to the installation of the Duro-Last System itself and not as it relates to other work performed, if any. Duro-Last's obligation includes, at Duro-Last's discretion, either the repair or replacement of part or all of the Duro-Last System and also includes the furnishing or cost of labor to repair the Duro-Last System provided the following conditions are met:

A. Duro-Last and Contractor have been paid in full for the Duro-Last System, its installation and any outstanding invoices issued by Duro-Last that arise after the installation;

B. The Duro-Last System has been approved by Duro-Last following inspection by an authorized Duro-Last Quality Assurance Technical Representative ("Duro-Last QA Tech Rep"), this No-Dollar Limit Warranty has been signed by a Duro-Last QA Tech Rep or Quality Assurance Manager, and the Contractor confirms that the Duro-Last System was installed in accordance with Duro-Last's specifications and written installation requirements;

C. The Owner has notified Duro-Last within 14 days of the discovery of any leak, failure or other alleged Duro-Last System defect. Owner must notify Duro-Last by calling the Duro-Last Quality Assurance Department at 1-866-284-9424, by e-mailing ws@duro-last.com, or by certified mail, return receipt requested;

D. The Owner allows Duro-Last's QA Tech Rep(s) and/or Duro-Last Contractor(s) access to the roof including, if necessary, the removal and replacement by Owner at Owner's expense any and all obstructions, including but not limited to: rooftop gardens, earth, soil, pavers, ballast, decks, patio and walking surface materials, photovoltaic system, and other overburden; and

E. Duro-Last authorizes the repair and, at Duro-Last's option, either Duro-Last's QA Tech Rep(s) or an authorized Contractor makes the repair.

II. OWNER'S RESPONSIBILITIES

The Owner is not entitled to recover under this No-Dollar Limit Warranty unless Owner exercises reasonable and diligent care in the maintenance of the Duro-Last System, including but not limited to inspecting and maintaining the Duro-Last System regularly and as needed, including after storms or natural disasters, and for removing any debris from the Duro-Last System, rooftop, and adjacent areas, and maintaining and keeping all drains in working order and clear of debris and other obstructions.

III. LIMITATIONS and EXCLUSIONS

A. This No-Dollar Limit Warranty does not apply to a Duro-Last System installed on a single-family residence.

B. Duro-Last shall not be liable for damages arising from defects in the design or construction of the building or roof assembly, including inadequate or insufficient drainage; nor shall Duro-Last be liable for any other products aside from the Duro-Last System.

C. Duro-Last is not liable for any Duro-Last System failure nor for subsequent damages arising from Acts of God or causes outside Duro-Last's control including, but not limited to:

1) Damage caused by fire, lightning, hurricane, gale, hail, tornado, flood, earthquake, animals, insects; or
2) Damage caused by accident, vandalism, intentional act, negligence or failure to use reasonable care, whether on the part of the Owner or another; or
3) Damage caused by any unauthorized modification to the Duro-Last System including, but not limited to: damage caused by unauthorized components used in installation or repair, by additional equipment or structures added to or made a part of the roof, by traffic, or by chemicals not normally found in nature or the like; or
4) Interior condensation and/or moisture entering the Duro-Last System through walls, copings, structural defects, HVAC systems, or any part of the building structure, including from adjacent buildings.

D. Duro-Last does not warrant the watertightness of metal products that are located outside of the termination of the Duro-Last membrane.

E. Duro-Last does not warrant against color change and/or pattern change and/or print change in the Duro-Last System.

F. Duro-Last shall have no liability under any theory of law for any claims, repairs, or other damages relating to the presence of asbestos or any vapors, fumes, molds, fungi, bacteria, spores, mycotoxins, or the like on or in the Duro-Last System or in the building or in the air or water serving the building.

G. This No-Dollar Limit Warranty is transferable to subsequent Owners only upon the express written consent of Duro-Last and at Duro-Last's sole discretion. Duro-Last reserves the right to require an inspection of the Duro-Last

OVER: CONTINUED ON BACK

System prior to transfer of this No-Dollar Limit Warranty. The Owner (undersigned below) must pay a $500 warranty transfer fee and must pay for any non-warranted repairs identified by Duro-Last during any pre-transfer inspection. A transfer of this No-Dollar Limit Warranty shall not be effective unless all outstanding Duro-Last invoices have been satisfied.

H. This No-Dollar Limit Warranty must be signed by a Duro-Last QA Tech Rep or Quality Assurance Manager. Coverage under the terms of this No-Dollar Limit Warranty begins on the Effective Date. The Effective Date is determined by Duro-Last. Failure of the Owner or Contractor to sign this No-Dollar Limit Warranty does not alter the Effective Date.

I. This No-Dollar Limit Warranty shall be governed by the laws of the State of Michigan without regard to principles of conflicts of law. Duro-Last and Owner hereby agree that the Circuit Court for the County of Saginaw, State of Michigan, or the United States Federal District Court for the Eastern District of Michigan in Bay City, shall have the exclusive jurisdiction to determine any and all disputes, or claims relating to this No-Dollar Limit Warranty and do hereby submit themselves to the sole personal jurisdiction of those Courts.

J. No claim, suit, or other proceeding arising out of or related to the Duro-Last products or these terms, including without limitation this No-Dollar Limit Warranty, may be brought by the Owner or anyone else after one (1) year from the date it accrues.

K. Duro-Last does not waive any rights under this No-Dollar Limit Warranty by refraining from exercising its rights in full in one or more instances.

THIS NO-DOLLAR LIMIT WARRANTY AND THE RESPONSIBILITIES AND REMEDIES STATED HEREIN ARE EXPRESSLY AGREED TO BY OWNER AND DURO-LAST AND CONSTITUTE THE SOLE WARRANTY AND REMEDIES OF THE OWNER FOR ANY ALLEGED DEFECT OR FAILURE OF THE DURO-LAST SYSTEM, WHETHER MEMBRANE, ACCESSORIES, OR CONTRACTOR WORKMANSHIP.

THERE ARE NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE (EITHER EXPRESS OR IMPLIED IN FACT, LAW OR CUSTOM) THAT EXTEND BEYOND THE EXPRESS TERMS STATED IN THIS NO-DOLLAR LIMIT WARRANTY TO THE FULL EXTENT DISCLAIMER IS PERMITTED BY LAW. OWNER AND DURO-LAST TOGETHER JOINTLY DISCLAIM ANY OTHER OR FURTHER WARRANTIES EXCEPT THOSE INCLUDED IN THIS DOCUMENT. IN ANY EVENT, ANY IMPLIED WARRANTY THAT MAY ARISE BY LAW IS LIMITED IN DURATION TO THE TERM HEREIN. THE REPAIR, OR REPLACEMENT PROVIDED HEREIN IS EXCLUSIVE AND IN LIEU OF ALL OTHER REMEDIES. DURO-LAST WILL HAVE NO LIABILITY TO ANYONE FOR CONSEQUENTIAL, SPECIAL, INCIDENTAL, INDIRECT, EXEMPLARY, OR PUNITIVE DAMAGES OF ANY KIND WHATSOEVER, INCLUDING WITHOUT LIMITATION PROPERTY DAMAGE, LOST PROFITS, LOST USE OR ANY OTHER PECUNIARY DAMAGE, WHETHER DUE TO ANY DEFECT IN THE PRODUCTS, BREACH OF THIS AGREEMENT, DELAY, NON-DELIVERY, NON-PERFORMANCE, RECALL, OR ANY OTHER REASON. ALL CLAIMS FOR NEGLIGENCE AND FOR FAILURE OF ESSENTIAL PURPOSE ARE EXPRESSLY WAIVED, RELEASED, AND EXCLUDED.

THERE ARE NO THIRD-PARTY BENEFICIARIES TO THESE TERMS. OWNER ACKNOWLEDGES THESE LIMITATIONS AND WAIVERS, DECLARES THAT THEY HAVE BEEN READ AND UNDERSTOOD, AND AGREES TO BE SO BOUND. ANY PAYMENT FOR THE DURO-LAST SYSTEM OR REGISTRATION OF THE WARRANTY WITH DURO-LAST SIGNIFIES THAT THE OWNER HAS VOLUNTARILY AND KNOWINGLY CONSENTED TO ALL TERMS.

The Contractor is not an agent of Duro-Last and does not have authority to bind Duro-Last. If any Contractor or sales representative made any statements about Duro-Last, its products, services, obligations, or warranties, those statements cannot be relied upon by Owner or any other party and cannot be attributed to Duro-Last. Furthermore, no person may change or modify any terms or conditions of this No-Dollar Limit Warranty, unless in writing and signed by the authorized representative of the Owner and by a Duro-Last officer or by the Duro-Last Quality Assurance Manager.

SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO SUCH A LIMITATION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS THAT VARY FROM STATE TO STATE. If any provision or individual term herein is invalid or unenforceable under any applicable law, the provision or term will be ineffective to that extent and for the duration of the illegality but the remaining provisions and terms will be unaffected.

DURO-LAST®, INC.
525 Morley Drive
Saginaw, MI 48601

ROGER GRAHL
QUALITY ASSURANCE SPECIALIST
Roger Grahl
Signature of Duro-Last QA Tech Rep or QA Manager

Wright State University
Name of Building

7600 State Route 703
Address of Building

Celina, Ohio 45822
City, State & Zip of Building

Entire Tenary Hall
Building Designation

04-24-2015
Effective Date

359846
Serial No.

Signature of Owner

Owner (printed)

Joe Bender
Signature of Contractor

Cottenman + Co.
Contractor (printed)

14250
Square Footage

Q 1360385
Warranty No.

Document 00 31 32

Geotechnical Data

(Document enclosed hereinafter)

CTL Engineering, Inc.
102 Commerce Drive, Wapakoneta, OH 45895
Phone: 419-738-1447 Fax: 419-738-7670
E-Mail: ctlwapak@ctleng.com

January 28, 2025

Fanning Howey Associates, Inc.
128 W. Market St.
Celina, OH 45822

Attention: Mr. Rodney D. Wiford, AIA, BD+C, REFP

Reference: Geotechnical Engineering Report
Workforce Development Center – WSU-231035
Wright State University Lake Campus
7639 State Route 703
Celina, OH - Mercer County
CTL Project No. 24050051WAP

Mr. Wiford:

CTL Engineering, Inc. has completed the geotechnical exploration for the above referenced project. The purpose of this exploration was to evaluate the subsurface conditions and provide recommendations and soil parameters for the design and construction of a new Workforce Development Center building. Various empirical correlations have been made in analyzing the subsurface soils of the site. These correlations were made using generally accepted geotechnical engineering practice and published documents.

Thank you for the opportunity to be of service to you on this project. If you have any questions, please contact our office.

Respectfully Submitted,

CTL ENGINEERING, INC.



Frederick L. Schoen, P.E.
Project Engineer

MH/FLS:mh

GEOTECHNICAL ENGINEERING REPORT

WORKFORCE DEVELOPMENT CENTER - WSU 231035

7639 STATE ROUTE 703
CELINA, MERCER COUNTY, OHIO
CTL PROJECT NO.: 24050051WAP

PREPARED FOR:

FANNING HOWEY ASSOCIATES, INC.
128 W. MARKET ST.
CELINA, OHIO 45822

PREPARED BY:

CTL ENGINEERING, INC.
102 COMMERCE DRIVE
P.O. BOX 44
WAPAKONETA, OH 45895

January 28, 2025

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APPENDIX C LABORATORY TEST RESULTS

I. PROJECT DESCRIPTION

This geotechnical exploration is for the design and proposed construction of a new Workforce Development Center building at Wright State University Lake Campus in Celina, Ohio. It is understood that the building will be a slab-on-grade structure that is approximately 10,000 square feet in area. It is assumed the building will be supported by conventional spread footings with a finish floor elevation at an elevation similar to the existing Ternary Hall near elevation 877.5 feet.

II. SUBSURFACE EXPLORATION

Nine (9) soil test borings were drilled within the proposed area of development on December 26, 2024. Five (5) of the soil test borings were drilled within the perimeter of the proposed structure and designated as B-01-24 through B-05-24. Four (4) soil test borings were drilled in the proposed pavement areas and are designated as B-06-24 through B-09-24. Borings B-01-24 through B-05-24 were each drilled to a depth of 20 feet below ground surface (bgs). Borings B-06-24 through B-09-24 were drilled to a depth of 10 feet bgs. The location of the project site and where the borings were positioned across the project site are presented with the Project & Boring Location Plans in *Appendix A* of this report.

Test borings were advanced utilizing 3.25-inch inside diameter hollow-stem augers with an all-terrain vehicle-mounted drill rig. Standard penetration tests (SPT) were conducted during drilling by utilizing an automatic 140-pound hammer, falling 30 inches, to drive 2-inch O.D. split-spoon samplers a distance of 18 inches.

Spilt-spoon soil samples obtained from drilling operations were preserved in glass jars, visually classified in the field and delivered to CTL Engineering's laboratory for testing and analysis. Representative samples were subjected to laboratory testing including natural moisture content, Atterberg Limits, grain-size distribution, and hand penetrometer tests.

Test boring records from this exploration are included as individual boring records (logs) found in *Appendix B* of this report.

Test boring coordinates were obtained using Google Earth™ computer software, internet-based satellite imagery, and a handheld GPS unit. Ground surface elevations at the test boring locations were determined utilizing the Ohio Department of Natural Resources GIS website (*https://gis.ohiodnr.gov/website/dgs/geologyviewer/#*) and the "Boring Locations" plan sheet provided by Fanning Howey Architects, Inc. Ground surface elevations at boring locations were interpolated from elevation contour lines and should be considered approximate.

III. FINDINGS

A. Observations

The site is currently an existing asphalt and gravel covered parking lot with some areas of grass and exposed soil subgrades. Pavements across the lot was observed to be in fair condition with areas of cracking, raveling asphalt, and a recently patched section of pavement. The ground surface is slightly rolling with surface water runoff being collected by storm sewer catch basins located throughout the existing parking lot. Ground topography near the northern portion of the site is higher in elevation than the terrain south of the existing Ternary Hall.

B. Subsurface Soil Conditions

Test borings B-02-24, B-04-24, B-05-24, B-07-24, and B-08-24 encountered a nominal thickness of 4 inches of asphalt pavement overlying 6 to 8 inches of crushed aggregate base course materials at their ground surface. Test boring B-01-24 encountered approximately 6 inches of landscape mulch at its surface given that it was positioned within an existing landscaped shrub-bed. Test borings B-03-24 and B-06-24 encountered 6 to 8 inches of topsoil at their ground surface. Test boring B-09-24 encountered 10 inches of gravel pavement at its surface.

Below the surface cover, borings B-01-24 through B-03-24 and B-07-24 encountered fine grained cohesive soils classified as fill and possible fill. These materials were described as lean clay (CL) with varying amounts of sand and gravel. The existing fill and possible fill materials exhibited Standard Penetration Test (SPT) N_{60}-values of 7 to 20 blows per foot (bpf) with moisture contents of 16 to 25 percent.

Below the surface covers, fills, and possible fill materials; borings encountered fine-grained cohesive soils extending down to the termination depths of the borings at 10 to 20 feet below existing surface grades. The fine-grained soils were described as lean clay (CL) with varying amounts of sand and gravel. These soils exhibited SPT N_{60}-values of 9 to 29 bpf, with natural moisture contents of 14 to 25 percent.

Groundwater

The depth to groundwater was recorded during drilling and at the completion of drilling after removing augers and prior to backfilling of the borehole. The depths to borehole cave-in depths were also determined prior to backfilling of the borehole. A summary of recorded groundwater levels and borehole cave-in depths are presented in *Table 1*.

It should be noted that fluctuations in groundwater levels should be expected over time due to variations in precipitation. Static groundwater levels can only be determined through observations made in cased holes over a long period of time. Groundwater levels typically are the highest during the spring months.

Table 1 – Groundwater Recordings and Borehole Cave-In Depths

Test Boring No.	Groundwater Depths (feet)		Cave-In Depth (ft)
	During Drilling	At Completion	
B-01-24	"Dry"	"Dry"	17.5
B-02-24	"Dry"	"Dry"	None
B-03-24	"Dry"	"Dry"	17.0
B-04-24	"Dry"	"Dry"	17.5
B-05-24	"Dry"	"Dry"	17.5
B-06-24	"Dry"	"Dry"	None
B-07-24	"Dry"	"Dry"	None
B-08-24	"Dry"	"Dry"	None
B-09-24	"Dry"	"Dry"	None

Laboratory Testing

Hand penetrometer test results are shown on the Test Boring Records in *Appendix B*. Selected soil samples were tested in the laboratory for Atterberg Limits and grain size distribution. The results of the soil laboratory tests are presented in *Appendix C* and are summarized below in *Table 2*.

.

Table 2 – Atterberg Limits and Grain Size Distribution Test Results

Boring	Sample	Depth (ft)	USCS	LL	PI	Percent Fines*	
						Silt	Clay
B-04-24	SS-2	3.5 – 5.0	CL	35	16	34	48
B-04-24	SS-4	8.5 – 10.0	CL	32	14	31	48
B-04-24	SS-6	18.5 – 20.0	CL	29	12	33	46

* Clay is defined as material particle size smaller than 0.005 mm

IV. ANALYSIS AND RECOMMENDATIONS

Upon review and analysis of the subsurface soil and groundwater conditions, the site is considered suitable for the construction of the proposed structure and pavements. For the purpose of our analysis and this report, it has been assumed that the finish floor elevation of the building will be at approximately 877.5± feet. CTL has assumed the building will be supported by spread foundations bearing on suitable soil materials consisting primarily of native soils or engineered fill that has been properly placed and compacted. Should the actual finish floor elevation of the proposed building be substantially different from this assumption, CTL should be contacted and be allowed to re-evaluate our recommendations.

Existing surface grades at boring locations within the building area range from elevation 877.5 to 879.3 feet including surface material thicknesses. In assuming a finish floor elevation of 877.5 feet, most of the area will only require very minor amounts of cut/fill to achieve design subgrade elevations.

The proposed building may be supported on spread foundations consisting of isolated column footings and/or continuous wall footings bearing on properly placed engineered fill or approved native soils. If soft or loose soils are encountered at foundation bearing elevations, these soils should be undercut and removed and lean concrete be placed up to the proposed footing bearing elevation. Floor slabs and pavements may be supported directly on a base course of approved granular material on top of approved soils or newly-placed engineered fill.

Discontinuous seepage water may be encountered during excavations for foundations and below-grade utilities, depending on the time of the construction and seasonal rainfall amount. If water is encountered during construction, localized sump pumps may be used to maintain a relatively dry excavation.

Excavations may be accomplished using conventional earth moving equipment. Excavation sidewalls should be sloped to meet OSHA standards or shored to protect workers.

Based on the preceding subsurface analysis from field and laboratory testing, the following recommendations are provided.

A. Site Preparation and Earthwork

1. All existing asphalt cover should be removed from the proposed construction limits. Any underground utilities located within the construction limits should be removed or relocated.

2. During earthwork operations, care should be taken to provide adequate drainage on the surface of exposed soils. Absorption of heavy rainfall, accumulations of water, and heavy construction traffic may result in softening of these soils, hence, severely weakening the strength of the subgrade soils.

3. Subsequent to surface material and unsuitable soil removal and prior to any fill placements, all exposed soil surfaces should be proof rolled with an approved 20-ton loaded, tandem-axle truck in the presence of the Geotechnical Engineer. Soft or loose soils, if encountered, should be mechanically aerated, dried, and recompacted or otherwise improved as directed by the Geotechnical Engineer.

4. Temporary excavations in excess of 4 feet in depth should be sloped or shored in accordance with OSHA regulations. Excavation sidewalls, for any underground utility placements or incidental retaining walls, should be laid back at a slope rate no steeper than 1:1 (Horizontal to Vertical). Excavation sidewalls may exhibit cave-in particularly if sand or granular soils or soft, loose fills are encountered. Excavation sidewalls should be laid back at a slope rate no steeper than 1½:1 (Horizontal to Vertical) if these materials are encountered. All excavation sidewalls should be observed and approved during construction by the Geotechnical Engineer.

5. Following acceptance of the exposed surfaces, fill materials required to raise the grade should consist of clean, on-site, inorganic, non-frozen soils. Fill materials should have a Liquid Limit less than 40, a Plasticity Index less than 20, a standard maximum dry density of at least 100 pounds per cubic foot, a maximum particle size of 3 inches, and should contain less than 4 percent (by weight) organic matter. Additional acceptable fill materials may consist of crushed limestone, sand, or gravel. Topsoil, frozen soil, and/or organically contaminated soils are not considered suitable for use as fill. All fill materials should be observed, tested, and approved by the Geotechnical Engineer.

6. Engineered fill should be placed in layers not to exceed 8 inches in loose thickness, with each layer compacted to 100 percent of the maximum dry density as determined by ASTM D-698 Standard Proctor method (AASHTO T-99) and ±2% of its optimum moisture content in structural or pavement areas, or as otherwise directed by the Geotechnical Engineer.

7. Fill placement should extend beyond the limits of the proposed building and pavements a minimum horizontal distance equal to the height of the fill or 5 feet, whichever is greater.

8. Depending upon the time of year and the precipitation rates preceding construction, seepage water may be encountered in the upper soils. Groundwater seepage is generally associated with water trapped within granular or existing fill layers interbedded within a mostly cohesive soil profile. These layers are typically discontinuous and are recharged by precipitation events or surface water. Care should be taken to avoid over-pumping and removal of soil fines, which may cause adverse settlement of not only the site but adjacent properties and/or structures.

B. Foundation Support

The proposed building may be constructed on shallow spread footings. Recommendations for the design and construction of shallow foundations are provided in the following paragraphs.

1. Provided that the above stated recommendations are adhered to, the proposed building may be supported onto continuous wall, isolated column spread footings constructed into native soils or newly-placed engineered fill. All footing bearing surfaces should be observed and approved by the Geotechnical Engineer.

2. Shallow foundation units may be proportioned using an allowable soil bearing capacity not to exceed 3,000 pounds per square foot (psf). This value applies to the total of all design loads using a factor of safety of 3.0.

   In the event that soils exhibit soft conditions at the proposed bottom of footing elevation, soils below the proposed footings should be removed to approved levels and lean concrete may then be placed up to the originally proposed footing bearing elevation.

3. Exterior footings should be constructed at a minimum depth of 36 inches below the lowest adjacent exterior grade to offset the effects of frost penetration.

4 Minimum widths for individual column and load bearing wall footings should be 24 and 16 inches, respectively. Minimum widths are recommended to provide a margin of safety against local or punching shear failure.

5. Settlement of footings supported as recommended may vary across the site due to variations in the soil's composition, void ratio, and loading. However, it is estimated that total and differential settlements will be within tolerable limits.

C. Slab Support

1. Floor slabs may be supported directly on a base course of approved granular material on top of approved soils or newly-placed engineered fill.

2. Granular base should be of an adequate thickness to support slabs and to act as a capillary break.

3. The proposed floor slab subgrade will most likely consist of native soils or newly-placed engineered fill. Assuming any proposed fill materials required to raise grades are consistent with existing soils, a Modulus of Subgrade Reaction value of 120 pounds per cubic inch may be used in the evaluation of subgrade soils.

D. Seismic Considerations

Based upon Section 1613 of the Ohio Building Code (OBC), a Site Class D may be used for seismic design. This Site Class was determined using the information obtained in test borings as well as published information in the vicinity of the project site.

E. Pavement Support

Existing subgrade soils are primarily cohesive silt and clay soils which may exhibit signs of instability during construction, particularly during the wetter months of the year. Air-drying of the clayey soils may be difficult, particularly during the winter months and the wet season (from October to May). Soft or loose soils, if encountered, should be mechanically aerated, dried, and re-compacted or undercut and replaced with compacted engineered fill, with or without use of a geotextile or geogrid, or as otherwise determined by the Geotechnical Engineer. A drying/stabilizing (chemical) agent such as lime or cement may also be added to the soils to facilitate drying and/or stability.

If instability is identified during proof rolling, the following options to stabilize the soils may be considered. Please note, these options are meant as guidelines and not intended to be an absolute solution for every situation encountered. Please note that recommended subgrade treatments may vary for building, pavement subgrade, engineered fill subgrade, and landscaped areas. **The Geotechnical Engineer should be consulted for each area identified as being unstable and a location-specific plan of action should be established.**

1. Drying of the underlying soils can be accomplished by scarifying the moist soils and allowing the soil to dry. This method is only practical in less than severe cases that exhibit minimal instability initially. The soils must be recompacted once dried.

2. Undercutting the unstable soils to an acceptable depth, typically one to several feet and backfilling the undercut with approved engineered fill consisting of:
   - on-site or borrowed soils with moisture contents within ±2% of its optimum moisture content. In severe cases, a geotextile fabric may be required between underlying weak soils and new fill.
   - borrowed crushed aggregate, typically conforming to the material gradation requirements of ASTM D2940. In severe cases, an approved multi-axial geogrid may be used as added support in pavement areas. The geogrid type, aggregate sizing, and undercut depths are usually site-specific and should be evaluated for each area identified.

3. Alternatively, the use of a chemical additive such as lime or cement may be applied to the unstable soils. It is estimated that an application rate of 5% of lime may be used to a depth of 12 inches. Chemical stabilization work should not be performed during wet or unsuitable weather as well as in temperatures less than 40 degrees Fahrenheit. Alternative application rates may be considered if field verification of subgrade stability is performed. It is recommended that an experienced contractor who specializes in chemical stabilization be consulted for the subgrade treatments.

The subgrade of paved areas should be observed and approved by the Geotechnical Engineer. Soils with a maximum dry weight of less than 100 pounds per cubic foot are unsuitable for use in the upper 12 inches of subgrade. Such soils should be replaced with other suitable soils or granular material.

Based on the soil types found within the upper several feet of the existing soil profiles and as identified with laboratory testing, an untreated soil CBR value of the subgrade soils is 5.0 percent.

Surficial soils are moderately plastic, cohesive soils and will be affected by their moisture contents. Therefore, it is highly recommended that any surface and subsurface water be permanently and quickly drained from the area to limit the weakening of the subgrade soil used for pavement support. Without drainage, any modification/stabilization procedure that is undertaken should be considered temporary.

It is recommended that a drainage system be designed to permanently dewater the subbase aggregate and associated subgrade soils and direct the water into the site's storm sewer system or away from any buildings and pavement. Finger drains should be installed in the area of the catch basins.

All pavement materials should conform to State of Ohio, Department of Transportation, Construction and Material Specifications.

V. CHANGED CONDITIONS

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project, and our experience with similar sites and subsurface conditions using generally accepted geotechnical engineering practices. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates drilled, they are not necessarily representative of the subsurface conditions between boring locations or subsurface conditions during other seasons of the year.

In the event that changes in the project are proposed, additional information becomes available, or if it is apparent that subsurface conditions are different from those provided in this report, CTL Engineering should be notified so that our recommendations can be modified, if required.

VI. TESTING AND OBSERVATION

During the design process, it is recommended that CTL Engineering work with the project designers to confirm that the geotechnical recommendations are properly incorporated into the final plans and specifications, and to assist with establishing criteria for observation and testing during construction.

CTL Engineering is not responsible for independent conclusions, opinions, and recommendations made by others based on the data and recommendations provided in this report. It is recommended that CTL be retained to provide construction quality control services on this project. If CTL Engineering is not retained for these services, CTL shall assume no responsibility for compliance with the design concepts or recommendations provided.

VII. CLOSING

This report has been prepared for the exclusive use of Fanning Howey Architects and Wright State University and their representatives for use only on this project. Our services have been performed in accordance with generally accepted Geotechnical Engineering principles and practices. No warranty is either expressed or implied.

The report addresses only the geotechnical issues and therefore, does not include environmental issues such as the presence or absence of hazardous or toxic materials at the project site.

Recommendations provided herein were developed from information obtained from field investigations, laboratory testing, information provided by the client and/or their representatives or consultants, as well as analysis by CTL Engineering personnel. Specific design and construction recommendations have been provided in various sections of the report. Therefore, the report should be used in its entirety.

CTL Engineering should be retained to provide construction quality control services. If CTL Engineering is not retained for these services, we shall assume no responsibility for compliance with the design concepts or recommendations provided. This report may not contain sufficient information for other parties or uses. CTL Engineering is not responsible for independent conclusions, opinions, and recommendations made by others based on the data and recommendations provided in this report.

If there is a substantial lapse of time between the submission of our report and the start of work at the site, or if significant differences in location and/or configuration of the project have developed, then CTL Engineering should be contacted to review the data and provide alternative recommendations, if necessary.

Thank you for the opportunity to be of service to you on this project. If you have any questions regarding our services, please contact our office.

Respectfully Submitted,
***CTL* ENGINEERING, INC.**

Mary Hughes, E.I.
Geotechnical Engineer

Fredrick Schoen, P.E.
Geotechnical Service Line Manager

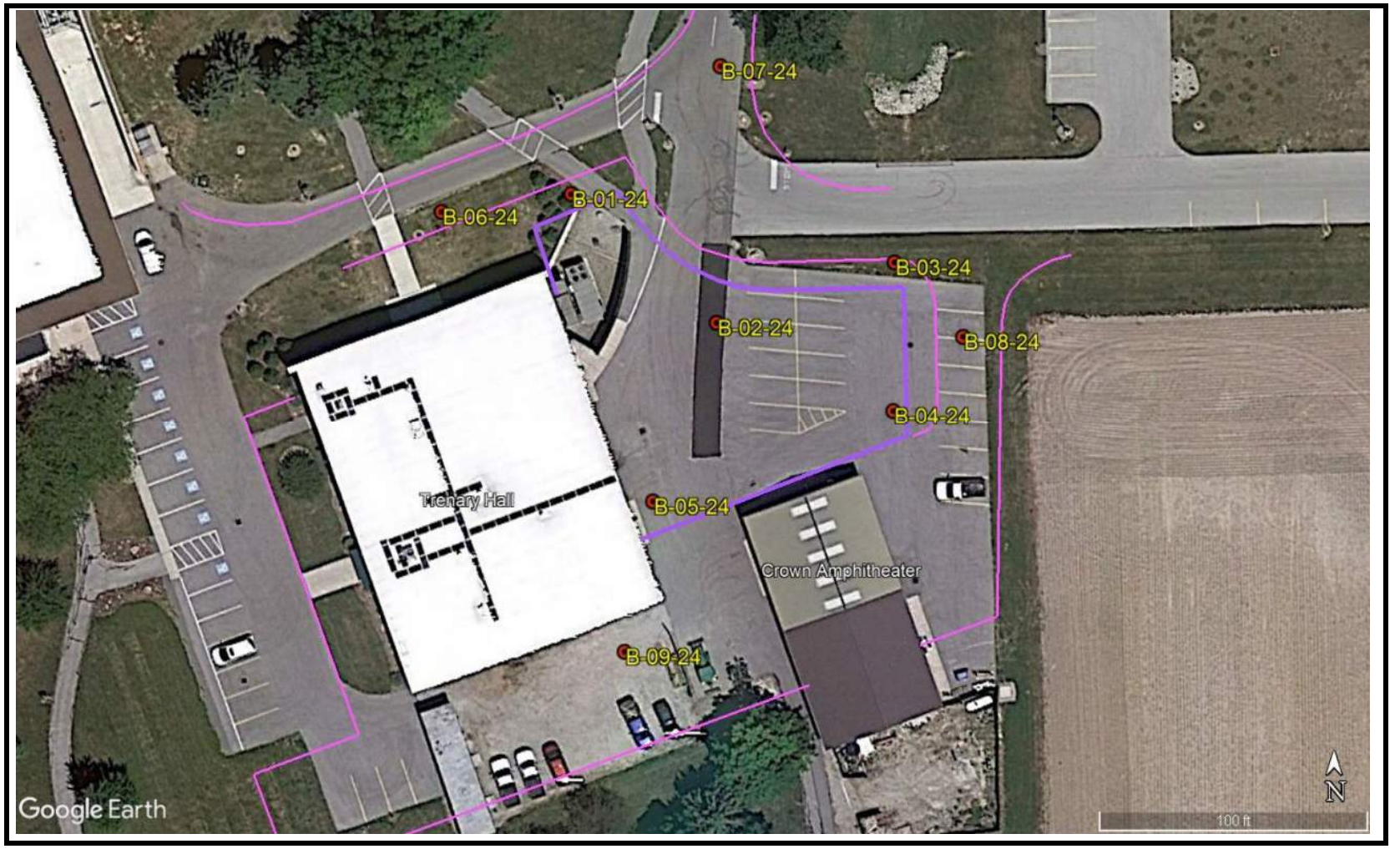
APPENDIX A

PROJECT AND BORING LOCATION PLANS WITH SOIL PROFILE SHEET





		PROJECT LOCATION PLAN			
		Date	Lake Campus Workforce Development Ctr.		
		1/17/2025	Wright State University		
CTL ENGINEERING, INC.		**Scale**	Trenary Hall / Crown Amphitheater		
GEOTECHNICAL ENGINEERS		Not-to-Scale	Celina, OH - Mercer County		
TESTING * INSPECTION		**Drawn By**	**Reviewed By**	**Page**	**CTL Project No.**
LABORATORY SERVICES		FS		1 of 1	24050051WAP



BORING LOCATION PLAN

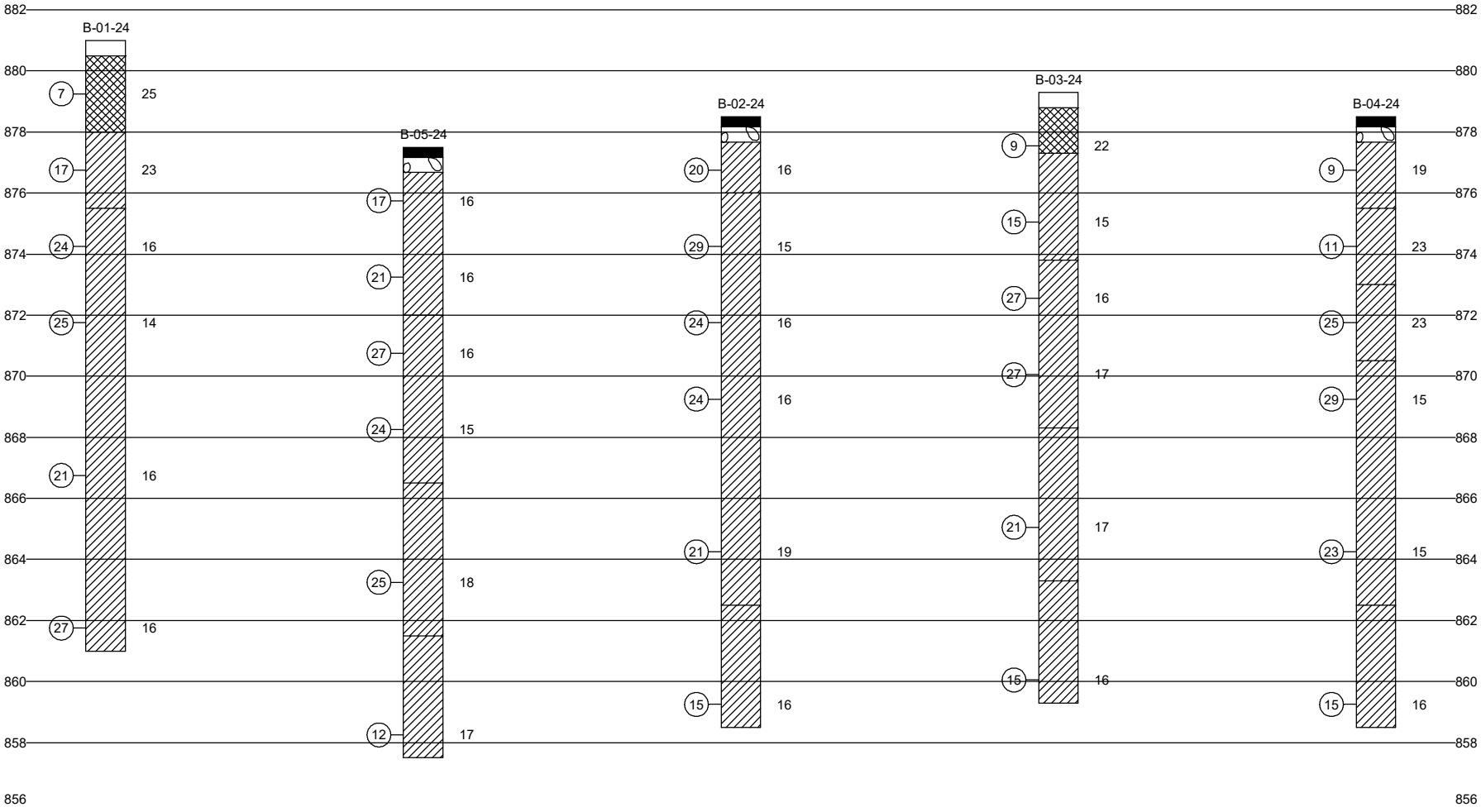
Lake Campus Workforce Development Ctr.
Wright State University
Trenary Hall / Crown Amphitheater
Celina, OH - Mercer County

CTL ENGINEERING, INC.
102 COMMERCE DR. P.O. BOX 44
WAPAKONETA, OHIO 45895
PHONE: (419) 738-1447
FAX: (419) 738-7670

EMPLOYEE OWNED
GEOTECHNICAL ENGINEERS
TESTING * INSPECTION
LABORATORY SERVICES

Scale	Drawn By	Reviewed By	Page	CTL Project No.
As Shown	FLS		1 of 1	24050051WAP

Date
1/17/2025



LEGEND

TOPSOIL, ASPHALT, GW, GP, GW-GM, GW-GC, GP-GM, GP-GC, GM, GC, GC-GM, SW, SP, SW-SM, SW-SC, SP-SM, SP-SC, SM, SC, SC-SM, ML, CL, CL-ML, OL, CH, MH, OH, PT, SHALE, SILTSTONE, LIMESTONE, FILL

GROUND WATER DURING DRILLING

GROUND WATER AT COMPLETION OF DRILLING

GROUND WATER AT "N" HOURS AFTER COMPLETION

W — MOISTURE CONTENT IN PERCENT (w)

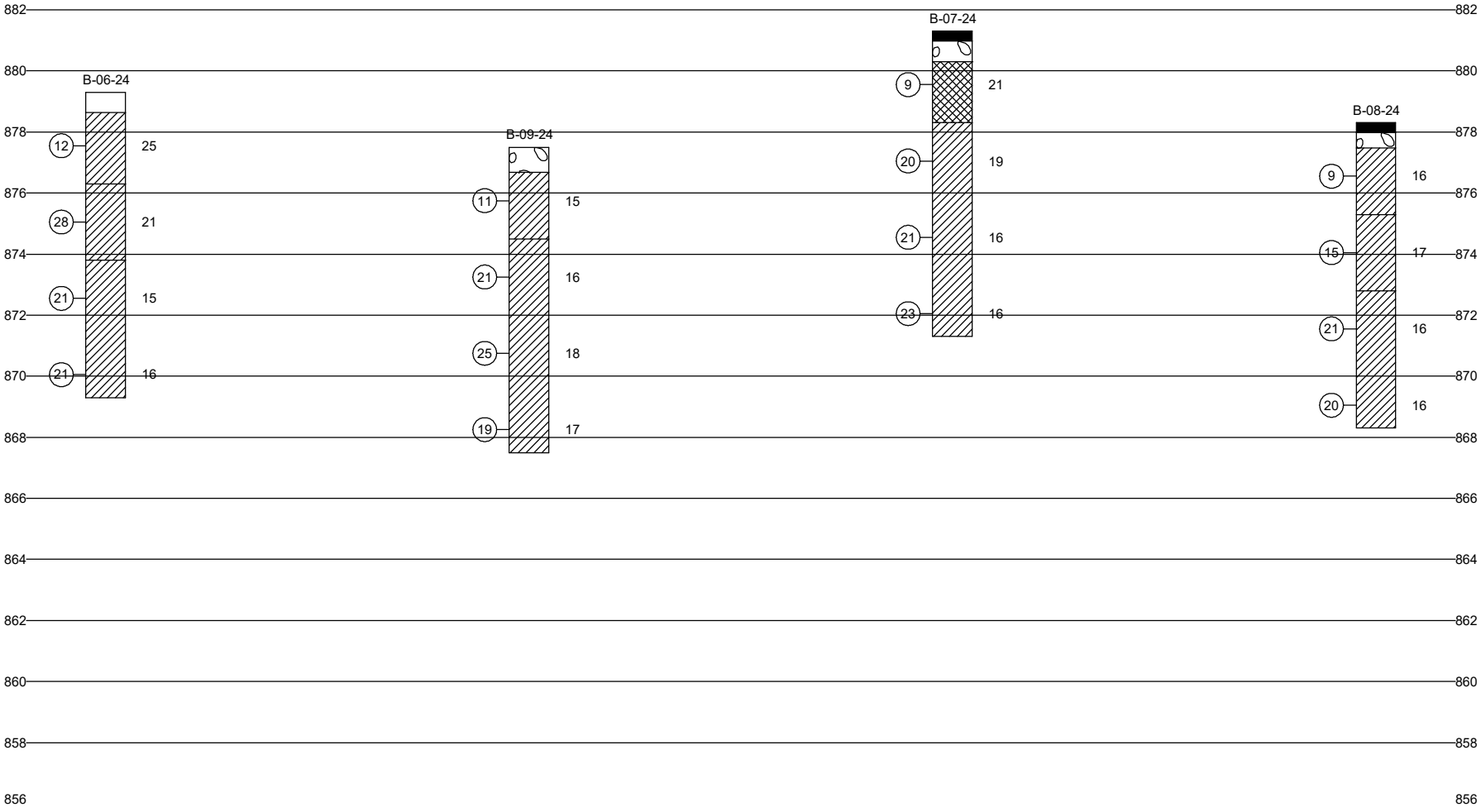
(N) — CORRECTED STANDARD PENETRATION IN BLOWS PER FOOT (N60)

CTL ENGINEERING
102 Commerce Drive
P.O. Box 44
Wapakoneta, OH 45895
Telephone: 419-738-1447
Fax: 419-738-7670
Email: ctlwapak@ctleng.com

SOIL PROFILE

DATE 1/16/2025	Fanning/Howey Associates, Inc.
SCALE AS SHOWN	WSULC Workforce Development Center Celina, Ohio

DRAWN BY	PAGE	PROJECT NUMBER
SB	1 OF 1	24050051WAP



LEGEND

TOPSOIL, ASPHALT, GW, GP, GW-GM, GW-GC, GP-GM, GP-GC, GM, GC, GC-GM, SW, SP, SW-SM, SW-SC, SP-SM, SP-SC, SM, SC, SC-SM, ML, CL, CL-ML, OL, CH, MH, OH, PT, SHALE, SILTSTONE, LIMESTONE, FILL

GROUND WATER DURING DRILLING

GROUND WATER AT COMPLETION OF DRILLING

GROUND WATER AT "N" HOURS AFTER COMPLETION

W — MOISTURE CONTENT IN PERCENT (w)

(N) — CORRECTED STANDARD PENETRATION IN BLOWS PER FOOT (N60)

CTL ENGINEERING
102 Commerce Drive
P.O. Box 44
Wapakoneta, OH 45895
Telephone: 419-738-1447
Fax: 419-738-7670
Email: ctlwapak@ctleng.com

SOIL PROFILE

DATE 1/16/2025	Fanning/Howey Associates, Inc.
SCALE AS SHOWN	WSULC Workforce Development Center Celina, Ohio

DRAWN BY	PAGE	PROJECT NUMBER
SB	1 OF 1	24050051WAP

APPENDIX B

TEST BORING RECORDS

EXPLANATION OF TERMS AND SOIL DESCRIPTIONS
(ASTM D2487 & ASTM D2488)

CONSISTENCY AND RELATIVE DENSITY DESCRIPTIONS

Descriptors for soil consistency used in this report are based upon the Standard Penetration Test (SPT), ASTM D 1587, with the penetration (N) values corrected to N_{60}, based upon the efficiency of the SPT Hammer (Energy Ratio) used for the soil sampling.

NON-COHESIVE SOILS

Consistency	SPT-N_{60} (bpf)
Very Loose	0 – 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 - 50
Very Dense	Over 50

COHESIVE SOILS

Consistency	SPT-N_{60} (bpf)
Very Soft	0 – 1
Soft	2 – 4
Medium Stiff	5 – 8
Stiff	9 – 15
Very Stiff	16 – 30
Hard	Over 30

COMPONENT MODIFIERS

ASTM D2488 (Visual-Manual)

Modifier	% by Weight
Trace of	0 – 1
Traces of	2 – 10
Little	11 – 20
Some	20 – 35
"And"	35 – 50

ASTM D2487 (USCS)

Modifier	% by Weight
with sand or gravel	15 – 29
Sandy or Gravelly	≥ 30
with silt or clay	5 – 12
Silty or Clayey	> 12
Organic	$LL_{oven}/LL_{air} < 0.75$

MOISTURE DESCRIPTIONS

Terms	Non-Cohesive Soils	Cohesive Soils
Dry	Moisture Absent	Powdery
Damp	Some Moisture	Below Plastic Limit
Moist	Damp to the Touch	Between Plastic and Liquid Limits
Wet	Visible Water	Above Liquid Limit

PARTICLE SIZE DESCRIPTIONS

Component	USCS Particle Size
Boulders	≥ 12-in. (300 mm)
Cobbles	< 12-in. (300 mm) to 3-in. (75 mm)
Gravel	< 3-in. (75 mm) to #4 Sieve (4.75 mm)
Sand	< #4 Sieve (4.75 mm) to #200 Sieve (0.074 mm)
Silt	#200 Sieve (0.074 mm) to 0.005 mm
Clay	< 0.005 mm

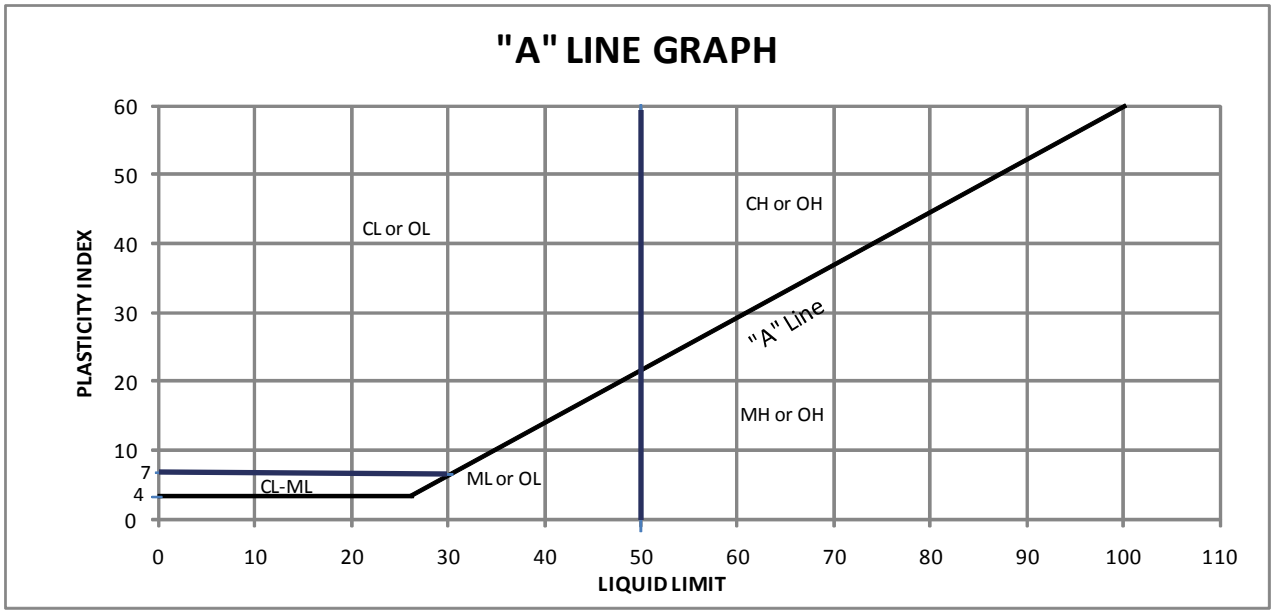
SOIL DESCRIPTIONS BASED ON THE UNIFIED SOIL CLASSIFICATION SYSTEM

ASTM D 2487 and D 2488

Major Division			Group Symbol	Letter Symbol	Group Name*
Coarse Grained Soils Less Than 50 Percent Passing the # 200 Sieve	Gravel - Percent GRAVEL > percent SAND	Gravel with < 5% Fines		GW	Well Graded GRAVEL
				GP	Poorly Graded GRAVEL
		Gravel with Between 5 and 15% Fines		GW-GM	Well Graded GRAVEL with silt
				GW-GC	Well Graded Gravel with clay
				GP-GM	Poorly Graded GRAVEL with silt
				GP-GC	Poorly Graded GRAVEL with clay
		Gravel with ≥ 15% Fines		GM	Silty GRAVEL
				GC	Clayey GRAVEL
	Sand - Percent SAND ≥ percent GRAVEL	Sand with < 5% Fines		SW	Well Graded SAND
				SP	Poorly Graded SAND
		Sand with Between 5 and 15% Fines		SW-SM	Well Graded SAND with silt
				SW-SC	Well Graded SAND with clay
				SP-SM	Poorly Graded SAND with silt
				SP-SC	Poorly Graded SAND with clay
		Sand with ≥ 15% Fines		SM	Silty SAND
				SC	Clayey SAND
Fine Grained Soils 50 percent or more Passing the # 200 Sieve	SILT and CLAY	Liquid Limit Less Than 50		ML	SILT
				CL	Lean CLAY
				CL-ML	SILTY CLAY
				OL	Organic SILT, CLAY, or SILTY CLAY
		Liquid Limit 50 or Greater		MH	Elastic SILT
				CH	Fat CLAY
				OH	Organic SILT or CLAY
Highly Organic Soils				PT	Peat

* Additional Modifiers			
	Coarse Grained Soils	with silt or clay	5 to 12 % Silt or Clay by weight
		Silty or Clayey	more than 12 % Silt or Clay by weight
	Fine Grained Soils	with sand or gravel	15 to 29 % Sand or Gravel by weight
		Sandy or Gravelly	30 % or more Sand or Gravel by weight

"A" LINE GRAPH



TEST BORING RECORD

CLIENT	: Fanning/Howey Associates, Inc.	BORING NO.:	**B-01-24**
PROJECT	: WSULC Workforce Development Center	SHEET	1 OF 1
LOCATION	: Celina, Ohio	DATE STARTED	: 12-26-24
PROJECT NO.	: 24050051WAP	DATE COMPLETED	: 12-26-24

BORING	ELEVATION : 881.0 Feet	RIG TYPE	: Geoprobe 7822	DRILLER	: J.B. (EnviroCore)
	STATION : 40.545456	CASING DIA.	: N/A	TEMPERATURE	:
	OFFSET : -84.508028	CORE SIZE	: N/A	WEATHER	:
	DEPTH : 20.0 Feet	HAMMER	: Automatic		
	BORING METHOD : 2.25-in HSA	ENERGY RATIO	: 80.0		

GROUNDWATER: Encountered at None At completion None Caved in at 17.5'

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	STRATUM DEPTH	SAMPLE NUMBER	SPT per 6"	N_{60}	RECOVERY (%)	MOISTURE CONTENT	TOTAL UNIT WEIGHT pcf	UNCONF. COMP., ksf	ATTERBERG LIMITS LL	PL	PI
880.5		**LANDSCAPE MULCH (6")**	0.5										
		Medium Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Slightly Organic, Moist **(FILL)**		SS-1	5 2 3	7	44	25		3.5*			
878.0			3.0										
		Very Stiff, Brown **LEAN CLAY with SAND (CL)**, Moist		SS-2	4 5 8	17	83	23		5.0*			
	5												
875.5			5.5										
				SS-3	6 7 11	24	72	16		9.0*			
				SS-4	5 8 11	25	89	14		9.0*			
	10												
		Very Stiff, Brown **LEAN CLAY with SAND (CL)**, Damp											
				SS-5	6 7 9	21	56	16		9.0*			
	15												
				SS-6	7 12 8	27	56	16		9.0*			
861.0	20	**BOTTOM OF BORING**	20.0										

GTL ENGINEERING LLC
102 Commerce Drive
P.O. Box 44
Wapakoneta, Ohio 45895
Telephone: 419-738-1447
Fax: 419-738-7670
Email: ctl@ctleng.com

BORING METHOD	SAMPLING METHOD	ABBREVIATIONS
HSA - Hollow Stem Auger	SS - Split Spoon Sample	* - Hand Penetrometer
SFA - Solid Flight Auger	ST - Shelby Tube Sample	LL - Liquid Limit
RC - Rock Coring	CR - Rock Core Sample	PL - Plastic Limit
MD - Mud Drilling	BS - Bag Sample	PI - Plasticity Index
WD - Wash Drilling		SPT - Standard Penetration Test
HA - Hand Auger		N_{60} - Standard Penetration Normalized to 60% Drill Rod ER

TEST BORING RECORD

CLIENT	: Fanning/Howey Associates, Inc.	BORING NO.:	**B-02-24**
PROJECT	: WSULC Workforce Development Center	SHEET	1 OF 1
LOCATION	: Celina, Ohio	DATE STARTED	: 12-26-24
PROJECT NO.	: 24050051WAP	DATE COMPLETED	: 12-26-24

BORING	ELEVATION : 878.5 Feet	RIG TYPE	: Geoprobe 7822	DRILLER	: J.B. (EnviroCore)
	STATION : 40.545329	CASING DIA.	: N/A	TEMPERATURE	:
	OFFSET : -84.507835	CORE SIZE	: N/A	WEATHER	:
	DEPTH : 20.0 Feet	HAMMER	: Automatic		
	BORING METHOD : 2.25-in HSA	ENERGY RATIO	: 80.0		

GROUNDWATER: Encountered at None At completion None Caved in at None

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	STRATUM DEPTH	SAMPLE NUMBER	SPT per 6"	N_{60}	RECOVERY (%)	MOISTURE CONTENT	TOTAL UNIT WEIGHT pcf	UNCONF., COMP., ksf	ATTERBERG LIMITS LL	PL	PI
878.2		**ASPHALT (4")**	0.3										
877.7		**BASE (6")**	0.8										
		Very Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Damp **(POSSIBLE FILL)**		SS-1	9 7 8	20	50	16		9.0*			
876.0			2.5										
	5			SS-2	7 9 13	29	89	15		9.0*			
				SS-3	6 7 11	24	100	16		9.0*			
	10	Very Stiff, Brown **LEAN CLAY with SAND (CL)**, Damp		SS-4	5 8 10	24	100	16		9.0*			
	15			SS-5	5 7 9	21	100	19		9.0*			
862.5			16.0										
		Stiff, Gray **LEAN CLAY with SAND (CL)**, Moist		SS-6	3 5 6	15	100	16		5.0*			
858.5	20	**BOTTOM OF BORING**	20.0										

102 Commerce Drive
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Wapakoneta, Ohio 45895
Telephone: 419-738-1447
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BORING METHOD	SAMPLING METHOD	ABBREVIATIONS
HSA - Hollow Stem Auger	SS - Split Spoon Sample	* - Hand Penetrometer
SFA - Solid Flight Auger	ST - Shelby Tube Sample	LL - Liquid Limit
RC - Rock Coring	CR - Rock Core Sample	PL - Plastic Limit
MD - Mud Drilling	BS - Bag Sample	PI - Plasticity Index
WD - Wash Drilling		SPT - Standard Penetration Test
HA - Hand Auger		N_{60} - Standard Penetration Normalized to 60% Drill Rod ER

TEST BORING RECORD

CLIENT : Fanning/Howey Associates, Inc.
PROJECT : WSULC Workforce Development Center
LOCATION : Celina, Ohio
PROJECT NO. : 24050051WAP

BORING NO.: **B-03-24**
SHEET 1 OF 1
DATE STARTED : 12-26-24
DATE COMPLETED : 12-26-24

BORING					
ELEVATION	: 879.3 Feet	RIG TYPE	: Geoprobe 7822	DRILLER	: J.B. (EnviroCore)
STATION	: 40.545389	CASING DIA.	: N/A	TEMPERATURE	:
OFFSET	: -84.507598	CORE SIZE	: N/A	WEATHER	:
DEPTH	: 20.0 Feet	HAMMER	: Automatic		
BORING METHOD	: 2.25-in HSA	ENERGY RATIO	: 80.0		

GROUNDWATER: Encountered at None At completion None ▨ Caved in at 17.0'

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	STRATUM DEPTH	SAMPLE NUMBER	SPT per 6"	N_{60}	RECOVERY (%)	MOISTURE CONTENT	TOTAL UNIT WEIGHT pcf	UNCONF., COMP., ksf	ATTERBERG LIMITS LL	PL	PI
878.8		**TOPSOIL (6")**	0.5										
877.3		Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Moist **(FILL)**	2.0	SS-1	2 3 4	9	39	22		5.5*			
873.8	5	Stiff, Brown **LEAN CLAY with SAND (CL)**, Damp	5.5	SS-2	2 4 7	15	44	15		9.0*			
				SS-3	4 8 12	27	56	16		9.0*			
868.3	10	Very Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Damp	11.0	SS-4	6 9 11	27	61	17		9.0*			
863.3	15	Very Stiff, Brownish Gray **LEAN CLAY with SAND (CL)**, Damp	16.0	SS-5	6 7 9	21	39	17		6.5*			
859.3	20	Stiff, Gray **LEAN CLAY with SAND (CL)**, Moist	20.0	SS-6	3 5 6	15	56	16		5.0*			
		BOTTOM OF BORING											

TEST BORING - WAPAK 24050051WAP.GPJ NEW CTL WITH N60.GDT 25/1/16

GTL ENGINEERING
102 Commerce Drive
P.O. Box 44
Wapakoneta, Ohio 45895
Telephone: 419-738-1447
Fax: 419-738-7670
Email: ctl@ctleng.com

BORING METHOD	SAMPLING METHOD	ABBREVIATIONS
HSA - Hollow Stem Auger	SS - Split Spoon Sample	* - Hand Penetrometer
SFA - Solid Flight Auger	ST - Shelby Tube Sample	LL - Liquid Limit
RC - Rock Coring	CR - Rock Core Sample	PL - Plastic Limit
MD - Mud Drilling	BS - Bag Sample	PI - Plasticity Index
WD - Wash Drilling		SPT - Standard Penetration Test
HA - Hand Auger		N_{60} - Standard Penetration Normalized to 60% Drill Rod ER

TEST BORING RECORD

CLIENT : Fanning/Howey Associates, Inc.
BORING NO.: **B-04-24**
PROJECT : WSULC Workforce Development Center
SHEET 1 OF 1
LOCATION : Celina, Ohio
DATE STARTED : 12-26-24
PROJECT NO. : 24050051WAP
DATE COMPLETED : 12-26-24

BORING					
ELEVATION	: 878.5 Feet	RIG TYPE	: Geoprobe 7822	DRILLER	: J.B. (EnviroCore)
STATION	: 40.545241	CASING DIA.	: N/A	TEMPERATURE	:
OFFSET	: -84.507599	CORE SIZE	: N/A	WEATHER	:
DEPTH	: 20.0 Feet	HAMMER	: Automatic		
BORING METHOD	: 2.25-in HSA	ENERGY RATIO	: 80.0		

GROUNDWATER: Encountered at None At completion None Caved in at 17.5'

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	STRATUM DEPTH	SAMPLE NUMBER	SPT per 6"	N_{60}	RECOVERY (%)	MOISTURE CONTENT	TOTAL UNIT WEIGHT pcf	UNCONF., COMP., ksf	ATTERBERG LIMITS LL	PL	PI
878.2		**ASPHALT (4")**	0.3										
877.7		**BASE (6")**	0.8										
		Stiff, Brown **LEAN CLAY with SAND (CL)**, Damp		SS-1	2 3 4	9	39	19		9.0*			
875.5			3.0										
		Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Traces of Gravel, Moist		SS-2	2 4 4	11	44	23		3.0*	35	19	16
873.0	5		5.5										
		Very Stiff, Brown **LEAN CLAY with SAND (CL)**, Moist		SS-3	3 8 11	25	67	23		2.5*			
870.5			8.0										
				SS-4	6 10 12	29	56	15		9.0*	32	18	14
	10												
		Very Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Damp											
				SS-5	2 7 10	23	61	15		9.0*			
	15												
862.5			16.0										
		Stiff, Brownish Gray **LEAN CLAY with SAND (CL)**, Traces of Gravel, Moist											
				SS-6	6 5 6	15	44	16		5.5*	29	17	12
858.5	20		20.0										
		BOTTOM OF BORING											

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102 Commerce Drive
P.O. Box 44
Wapakoneta, Ohio 45895
Telephone: 419-738-1447
Fax: 419-738-7670
Email: ctl@ctleng.com

BORING METHOD	SAMPLING METHOD	ABBREVIATIONS
HSA - Hollow Stem Auger	SS - Split Spoon Sample	* - Hand Penetrometer
SFA - Solid Flight Auger	ST - Shelby Tube Sample	LL - Liquid Limit
RC - Rock Coring	CR - Rock Core Sample	PL - Plastic Limit
MD - Mud Drilling	BS - Bag Sample	PI - Plasticity Index
WD - Wash Drilling		SPT - Standard Penetration Test
HA - Hand Auger		N_{60} - Standard Penetration Normalized to 60% Drill Rod ER

TEST BORING RECORD

CLIENT	: Fanning/Howey Associates, Inc.	BORING NO.:	**B-05-24**
PROJECT	: WSULC Workforce Development Center	SHEET	1 OF 1
LOCATION	: Celina, Ohio	DATE STARTED	: 12-26-24
PROJECT NO.	: 24050051WAP	DATE COMPLETED	: 12-26-24

BORING	ELEVATION : 877.5 Feet	RIG TYPE	: Geoprobe 7822	DRILLER	: J.B. (EnviroCore)
	STATION : 40.545150	CASING DIA.	: N/A	TEMPERATURE	:
	OFFSET : -84.507920	CORE SIZE	: N/A	WEATHER	:
	DEPTH : 20.0 Feet	HAMMER	: Automatic		
	BORING METHOD : 2.25-in HSA	ENERGY RATIO	: 80.0		

GROUNDWATER: Encountered at None At completion None ▨ Caved in at 17.5'

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	STRATUM DEPTH	SAMPLE NUMBER	SPT per 6"	N_{60}	RECOVERY (%)	MOISTURE CONTENT	TOTAL UNIT WEIGHT pcf	UNCONF., COMP., ksf	ATTERBERG LIMITS LL	PL	PI
877.2		**ASPHALT (4")**	0.3										
876.7		**BASE (6")**	0.8										
		Very Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Damp		SS-1	6 6 7	17	50	16		9.0*			
				SS-2	4 6 10	21	100	16		9.0*			
872.0	5		5.5										
		Very Stiff, Brown **LEAN CLAY with SAND (CL)**, Damp		SS-3	5 8 12	27	100	16		9.0*			
				SS-4	5 8 10	24	100	15		9.0*			
866.5	10		11.0										
		Very Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Damp		SS-5	4 8 11	25	100	18		9.0*			
861.5	15		16.0										
		Stiff, Gray **LEAN CLAY with SAND (CL)**, Moist		SS-6	3 4 5	12	83	17		5.0*			
857.5	20		20.0										
		BOTTOM OF BORING											

GTL ENGINEERING

102 Commerce Drive
P.O. Box 44
Wapakoneta, Ohio 45895
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BORING METHOD	SAMPLING METHOD	ABBREVIATIONS
HSA - Hollow Stem Auger	SS - Split Spoon Sample	* - Hand Penetrometer
SFA - Solid Flight Auger	ST - Shelby Tube Sample	LL - Liquid Limit
RC - Rock Coring	CR - Rock Core Sample	PL - Plastic Limit
MD - Mud Drilling	BS - Bag Sample	PI - Plasticity Index
WD - Wash Drilling		SPT - Standard Penetration Test
HA - Hand Auger		N_{60} - Standard Penetration Normalized to 60% Drill Rod ER

TEST BORING RECORD

CLIENT : Fanning/Howey Associates, Inc.
PROJECT : WSULC Workforce Development Center
LOCATION : Celina, Ohio
PROJECT NO. : 24050051WAP

BORING NO.: **B-06-24**
SHEET 1 OF 1
DATE STARTED : 12-26-24
DATE COMPLETED : 12-26-24

BORING ELEVATION	: 879.3 Feet	RIG TYPE	: Geoprobe 7822	DRILLER	: J.B. (EnviroCore)
STATION	: 40.545439	CASING DIA.	: N/A	TEMPERATURE	:
OFFSET	: -84.508201	CORE SIZE	: N/A	WEATHER	:
DEPTH	: 10.0 Feet	HAMMER	: Automatic		
BORING METHOD	: 2.25-in HSA	ENERGY RATIO	: 80.0		

GROUNDWATER: Encountered at None At completion None Caved in at None

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	STRATUM DEPTH	SAMPLE NUMBER	SPT per 6"	N_{60}	RECOVERY (%)	MOISTURE CONTENT	TOTAL UNIT WEIGHT pcf	UNCONF., COMP., ksf	ATTERBERG LIMITS LL	PL	PI
878.6		**TOPSOIL (8")**	0.7										
		Stiff, Brown **LEAN CLAY with SAND (CL)**, Moist		SS-1	4 4 5	12	83	25		4.5*			
876.3			3.0										
	5	Very Stiff, Brown **LEAN CLAY with SAND (CL)**, Trace Gravel, Moist		SS-2	6 10 11	28	83	21		5.0*			
873.8			5.5										
		Very Stiff, Brown **LEAN CLAY with SAND (CL)**, Damp		SS-3	4 7 9	21	61	15		9.0*			
				SS-4	5 7 9	21	78	16		9.0*			
869.3	10	**BOTTOM OF BORING**	10.0										
	15												
	20												

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Wapakoneta, Ohio 45895
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BORING METHOD	SAMPLING METHOD	ABBREVIATIONS
HSA - Hollow Stem Auger	SS - Split Spoon Sample	* - Hand Penetrometer
SFA - Solid Flight Auger	ST - Shelby Tube Sample	LL - Liquid Limit
RC - Rock Coring	CR - Rock Core Sample	PL - Plastic Limit
MD - Mud Drilling	BS - Bag Sample	PI - Plasticity Index
WD - Wash Drilling		SPT - Standard Penetration Test
HA - Hand Auger		N_{60} - Standard Penetration Normalized to 60% Drill Rod ER

TEST BORING RECORD

CLIENT	: Fanning/Howey Associates, Inc.	BORING NO.:	**B-07-24**
PROJECT	: WSULC Workforce Development Center	SHEET	1 OF 1
LOCATION	: Celina, Ohio	DATE STARTED	: 12-26-24
PROJECT NO.	: 24050051WAP	DATE COMPLETED	: 12-26-24

BORING	ELEVATION : 881.3 Feet	RIG TYPE	: Geoprobe 7822	DRILLER	: J.B. (EnviroCore)
	STATION : 40.545583	CASING DIA.	: N/A	TEMPERATURE	:
	OFFSET : -84.507830	CORE SIZE	: N/A	WEATHER	:
	DEPTH : 10.0 Feet	HAMMER	: Automatic		
	BORING METHOD : 2.25-in HSA	ENERGY RATIO	: 80.0		

GROUNDWATER: Encountered at None At completion None Caved in at None

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	STRATUM DEPTH	SAMPLE NUMBER	SPT per 6"	N_{60}	RECOVERY (%)	MOISTURE CONTENT	TOTAL UNIT WEIGHT pcf	UNCONF., COMP., ksf	ATTERBERG LIMITS LL	PL	PI
881.0		**ASPHALT (4")**	0.3										
880.3		**BASE (8")**	1.0										
		Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Traces of Gravel, Moist **(FILL)**		SS-1	2 3 4	9	56	21		8.0*			
878.3			3.0										
	5	Very Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Traces of Gravel, Damp		SS-2	6 6 9	20	67	19		9.0*			
				SS-3	6 7 9	21	100	16		9.0*			
				SS-4	5 7 10	23	94	16		9.0*			
871.3	10	**BOTTOM OF BORING**	10.0										
	15												
	20												

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BORING METHOD	SAMPLING METHOD	ABBREVIATIONS
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WD - Wash Drilling		SPT - Standard Penetration Test
HA - Hand Auger		N_{60} - Standard Penetration Normalized to 60% Drill Rod ER

TEST BORING RECORD

CLIENT	: Fanning/Howey Associates, Inc.	BORING NO.:	**B-08-24**
PROJECT	: WSULC Workforce Development Center	SHEET	1 OF 1
LOCATION	: Celina, Ohio	DATE STARTED	: 12-26-24
PROJECT NO.	: 24050051WAP	DATE COMPLETED	: 12-26-24

BORING	ELEVATION : 878.3 Feet	RIG TYPE	: Geoprobe 7822	DRILLER	: J.B. (EnviroCore)
	STATION : 40.545315	CASING DIA.	: N/A	TEMPERATURE	:
	OFFSET : -84.507506	CORE SIZE	: N/A	WEATHER	:
	DEPTH : 10.0 Feet	HAMMER	: Automatic		
	BORING METHOD : 2.25-in HSA	ENERGY RATIO	: 80.0		

GROUNDWATER: Encountered at None At completion None Caved in at None

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	STRATUM DEPTH	SAMPLE NUMBER	SPT per 6"	N_{60}	RECOVERY (%)	MOISTURE CONTENT	TOTAL UNIT WEIGHT pcf	UNCONF., COMP., ksf	ATTERBERG LIMITS LL	PL	PI
878.0		**ASPHALT (4")**	0.3										
877.5		**BASE (6")**	0.8										
		Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Damp		SS-1	5 3 4	9	44	16		9.0*			
875.3			3.0										
		Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Damp		SS-2	6 5 6	15	56	17		9.0*			
872.8	5		5.5										
		Very Stiff, Brown **LEAN CLAY with SAND (CL)**, Damp		SS-3	8 7 9	21	89	16		9.0*			
				SS-4	5 6 9	20	89	16		9.0*			
868.3	10	**BOTTOM OF BORING**	10.0										
	15												
	20												

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HSA - Hollow Stem Auger	SS - Split Spoon Sample	* - Hand Penetrometer
SFA - Solid Flight Auger	ST - Shelby Tube Sample	LL - Liquid Limit
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MD - Mud Drilling	BS - Bag Sample	PI - Plasticity Index
WD - Wash Drilling		SPT - Standard Penetration Test
HA - Hand Auger		N_{60} - Standard Penetration Normalized to 60% Drill Rod ER

TEST BORING RECORD

CLIENT	: Fanning/Howey Associates, Inc.	BORING NO.:	**B-09-24**
PROJECT	: WSULC Workforce Development Center	SHEET	1 OF 1
LOCATION	: Celina, Ohio	DATE STARTED	: 12-26-24
PROJECT NO.	: 24050051WAP	DATE COMPLETED	: 12-26-24

BORING	ELEVATION : 877.5 Feet	RIG TYPE	: Geoprobe 7822	DRILLER	: J.B. (EnviroCore)
	STATION : 40.545000	CASING DIA.	: N/A	TEMPERATURE	:
	OFFSET : -84.507958	CORE SIZE	: N/A	WEATHER	:
	DEPTH : 10.0 Feet	HAMMER	: Automatic		
	BORING METHOD : 2.25-in HSA	ENERGY RATIO	: 80.0		

GROUNDWATER: Encountered at None At completion None Caved in at None

STRATUM ELEVATION	SAMPLE DEPTH	SOIL/MATERIAL DESCRIPTION	STRATUM DEPTH	SAMPLE NUMBER	SPT per 6"	N_{60}	RECOVERY (%)	MOISTURE CONTENT	TOTAL UNIT WEIGHT pcf	UNCONF., COMP., ksf	ATTERBERG LIMITS LL	PL	PI
876.7		**GRAVEL (10")**	0.8										
		Stiff, Brown and Gray **LEAN CLAY with SAND (CL)**, Damp		SS-1	2 4 4	11	72	15		9.0*			
874.5			3.0										
	5			SS-2	3 7 9	21	67	16		9.0*			
		Very Stiff, Brown **LEAN CLAY with SAND (CL)**, Traces fo Gravel, Damp		SS-3	4 8 11	25	78	18		9.0*			
				SS-4	5 6 8	19	94	17		9.0*			
867.5	10	**BOTTOM OF BORING**	10.0										
	15												
	20												

GTL ENGINEERING

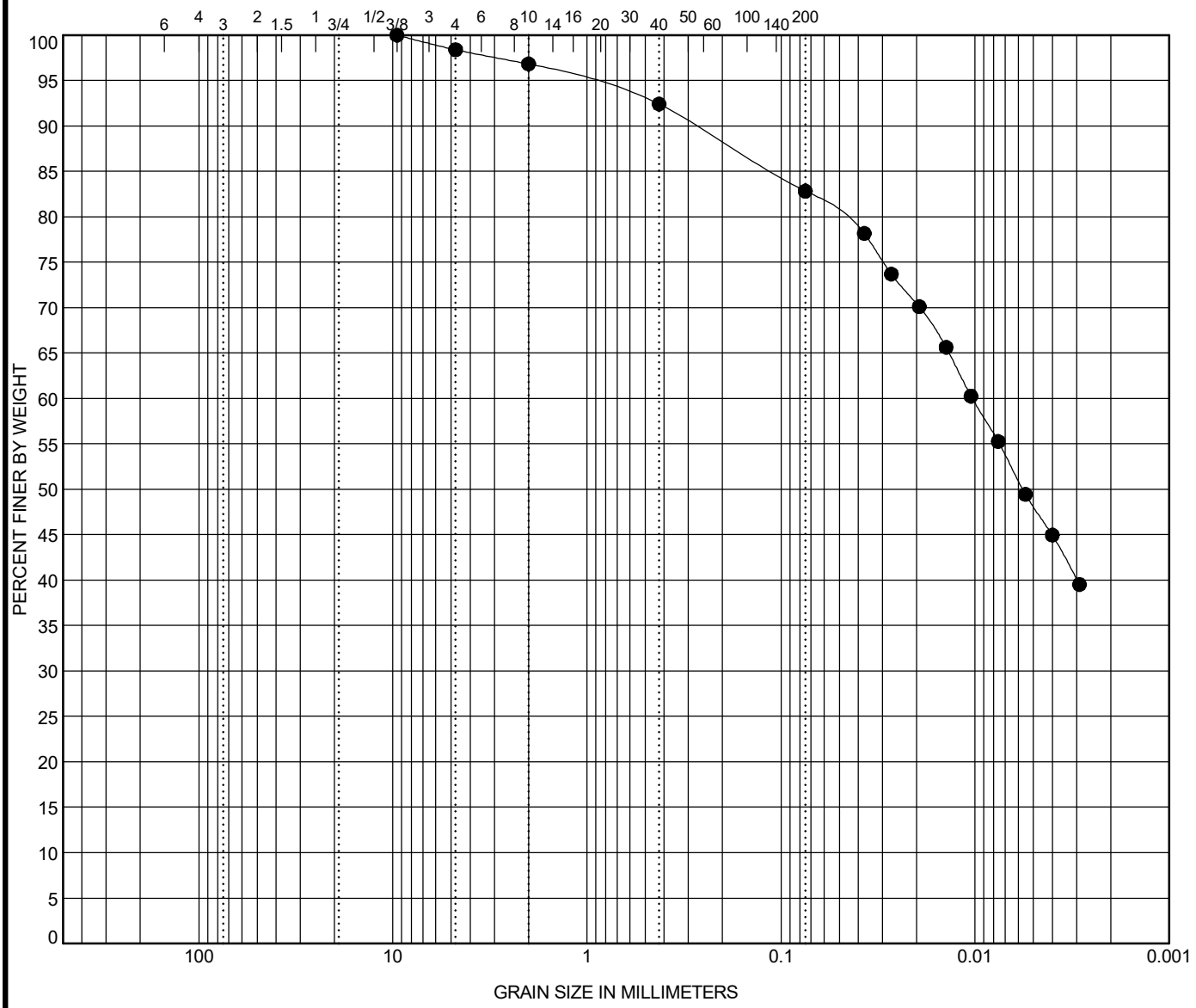
102 Commerce Drive
P.O. Box 44
Wapakoneta, Ohio 45895
Telephone: 419-738-1447
Fax: 419-738-7670
Email: ctl@ctleng.com

BORING METHOD	SAMPLING METHOD	ABBREVIATIONS
HSA - Hollow Stem Auger	SS - Split Spoon Sample	* - Hand Penetrometer
SFA - Solid Flight Auger	ST - Shelby Tube Sample	LL - Liquid Limit
RC - Rock Coring	CR - Rock Core Sample	PL - Plastic Limit
MD - Mud Drilling	BS - Bag Sample	PI - Plasticity Index
WD - Wash Drilling		SPT - Standard Penetration Test
HA - Hand Auger		N_{60} - Standard Penetration Normalized to 60% Drill Rod ER

TEST BORING - WAPAK 24050051WAP.GPJ NEW CTL WITH N60.GDT 25/1/16

APPENDIX C

LABORATORY TEST RESULTS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●**B-04-24**	**SS-2**	**3.5**	**LEAN CLAY with SAND(CL)**	**23**	**35**	**19**	**16**		

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●**B-04-24**	**SS-2**	**3.5**	**9.525**	**0.01**	**0.006**			**2**	**16**	**34**	**48**

CTL Engineering
102 Commerce Dr., P.O. Box 44
Wapakoneta, OH 45895
Telephone: (419) 738-1447
Fax: (419) 738-7670

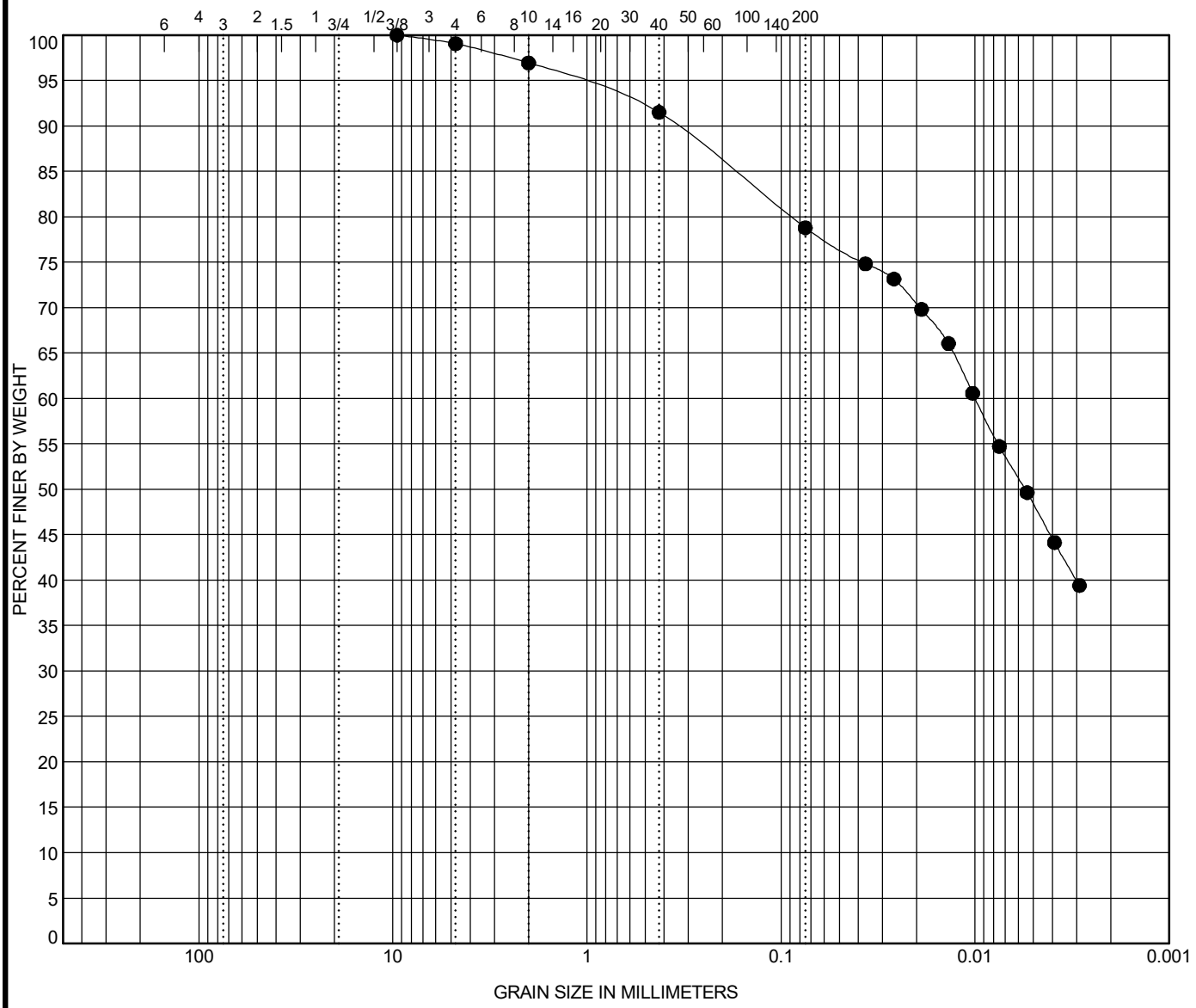
GRAIN SIZE DISTRIBUTION

Project: WSULC Workforce Development Center

Location: Celina, Ohio

CTL Project Number: 24050051WAP

GRADATION - WAPAK 24050051WAP.GPJ NEW CTL WITH N60.GDT 25/1/15



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● **B-04-24**	**SS-4**	**8.5**	**LEAN CLAY with SAND(CL)**	**15**	**32**	**18**	**14**		

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-04-24**	**SS-4**	**8.5**	**9.525**	**0.01**	**0.006**			**1**	**20**	**31**	**48**

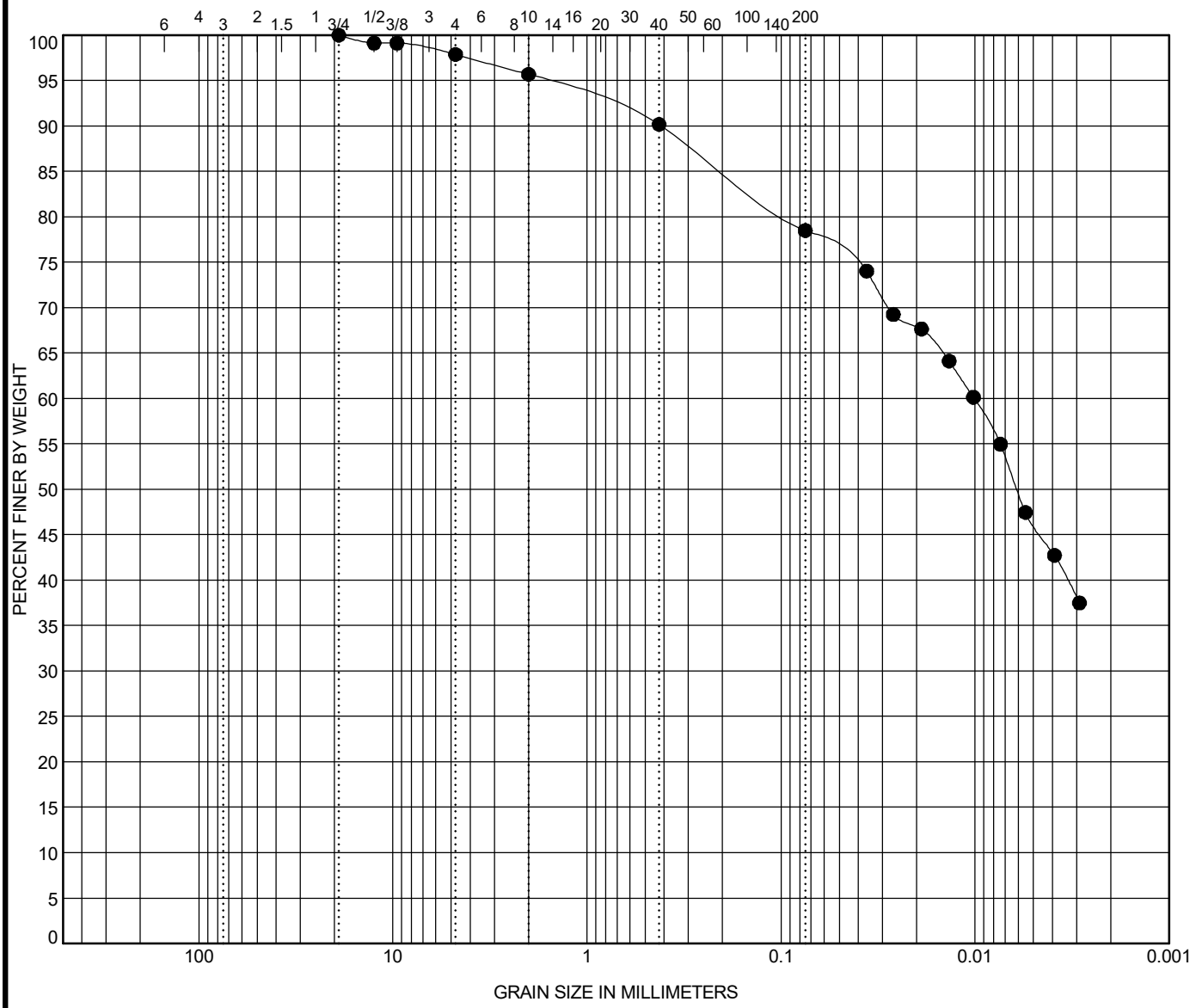
CTL Engineering
102 Commerce Dr., P.O. Box 44
Wapakoneta, OH 45895
Telephone: (419) 738-1447
Fax: (419) 738-7670

GRAIN SIZE DISTRIBUTION

Project: WSULC Workforce Development Center

Location: Celina, Ohio

CTL Project Number: 24050051WAP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● **B-04-24**	**SS-6**	**18.5**	**LEAN CLAY with SAND(CL)**	**16**	**29**	**17**	**12**		

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B-04-24**	**SS-6**	**18.5**	**19**	**0.01**	**0.006**			**2**	**19**	**33**	**46**

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Wapakoneta, OH 45895
Telephone: (419) 738-1447
Fax: (419) 738-7670

GRAIN SIZE DISTRIBUTION

Project: WSULC Workforce Development Center

Location: Celina, Ohio

CTL Project Number: 24050051WAP

GRADATION - WAPAK 24050051WAP.GPJ NEW CTL WITH N60.GDT 25/1/15

Document 00 41 13 - Bid Form (General Contract / Electronic Bid)
State of Ohio Standard Requirements for Public Facility Construction

THIS SAMPLE BID FORM IS PROVIDED WITH THE PROJECT MANUAL AS A PLACEHOLDER ONLY – SUBMIT YOUR BID USING THE ELECTRONIC BID FORM ON HTTPS://BIDEXPRESS.COM

General Info

Alt Total: Bid Total:

Deadline
10/28/2026 2:00 PM EDT/EST»

Description
Lake Campus Workforce Development Project»

Posted
October 7, 2026

Number
Project No. WSU-231035

Business Name
Wright State University

Procurement Documents

01 10 00_Solicitation
→ Notice to Bidders

224102.00_WSU_CD Project Manual
→ Procurement & Contracting Requirements and Specifications

224102.00_WSU_CD Drawings
→ Plans, elevations, sections, details, and schedules

«3» Attachments

Contract Times and Addenda

Contract Times

The time for Substantial Completion of all Work is «NNN» consecutive days from the Notice to Proceed.

Acknowledgement of receipt of Addenda

Date Addendum #1 Received	Date Addendum #2 Received	Date Addendum #3 Received	Date Addendum #4 Received

Unit Price Instructions

Enter the price per unit of measure in the Bid Form and the extension will be automatically calculate. Include the Extension for each and every Unit Price in the Base Bid. Unit prices will be used solely for the purpose of determining the adjustment to the Contract Sum for differences between the estimated quantities on the electronic Bid Form and the actual quantities provided.

Unit Prices (General Contract)

Item	Description	Quantity	Unit Price*	Unit of Measure	Extension
Unit Price U-1	Unsatisfactory Soils	50	_____	C.Y.	
1 Items				**Total:**	

Base Bid Instructions

Enter the amount of the Base Bid for ALL LABOR AND MATERIALS to complete the scope of Work. Include the amount of each Allowance (if applicable) and the subtotal of each Unit Price Extension (if applicable) in the Base Bid amount. Failure to include Allowance or Unit Price Extensions in the Base Bid is the responsibility of the Bidder and will not be sufficient reason for adjustment of the Bid amount after the Bid deadline. Do not include Alternates (if applicable) in the Base Bid amount.

Base Bid (General Contract)

Item	Description	Base Bid Amount*	Extension
Base Bid	All Labor and Materials (include Unit Price Extensions above)	_____	
1 Item		**Total:**	

Alternate Instructions

Enter the amount of each and every Alternate to ADD TO or DEDUCT FROM the Base Bid. Indicate amounts to DEDUCT FROM the Base Bid by entering a minus sign (-) before the amount entered. Do not include Alternate amounts in the Base Bid.

Alternates (General Contract)

Item	Description	Alternate Amount*	Extension
! Alternate: Owner-agency may award independently from entire bid.			
! Alternates are not included in bid total.			
Alternate 1	Corridor Refurbish	_____	
Alternate 2	Temperature Control Systems	_____	
Alternate 3	West Entrance Canopy Replacement	_____	
Alternate 4	Screening Mechanical Yard	_____	
Alternate 5	Refinish Room 133	_____	
Alternate 6	Landscaping	_____	
6 Items	**Alternate Total:**	**Total:**	

Bidder Affirmation and Disclosure

The Bidder acknowledges that by submitting its Bid, the Bidder has read and understands the applicable Executive Orders regarding the prohibitions of performance of offshore services, locating State data offshore in any way, or purchasing from Russian institutions or companies. If awarded a Contract, the Bidder will become the Contractor and affirms that both the Contractor and its Subcontractors shall perform no services requested under this Contract outside of the United States.

The Bidder shall provide the locations where services under this Contract will be performed in the spaces provided below or by attachment. Failure to provide this information as part of its Bid may cause the Bidder to be deemed non-responsive and no further consideration will be given to its Bid. If the Bidder will not be using Subcontractors, indicate "Not Applicable" in the appropriate spaces.

1. Principal business location of Contractor:

Contractor Address*

City, State, and Zip*

Name / Principal business location of Subcontractor(s), if known at time of Bid deadline:

Subcontractor Name*

Address, City, State, and Zip*

2. Location(s) where services will be performed by Contractor (Project Sites):

Name*

Address, City, State, and Zip*

Name(s) / Location(s) where services will be performed by Subcontractors (Project Sites):

Subcontractor Name

Address, City, State, and Zip

3. Location(s) where State data will be located by Contractor:

Address*

City, State, and Zip*

Location(s) where State data will be located by Subcontractor(s), if known at time of Bid deadline:

Subcontractor Name

Address, City, State, and Zip

Bidder also affirms, understands and agrees that the Contractor and its Subcontractors are under a duty to disclose to the State any change or shift in location of services performed by the Contractor or its Subcontractors before, during and after execution of any Contract with the State. Bidder agrees it shall so notify the State immediately of any such change or shift in location of its services. The State has the right to immediately terminate the contract, unless a duly signed waiver from the State has been attained by the Contractor to perform the services outside the United States.

On behalf of the Bidder, I acknowledge that I am duly authorized to execute this electronic Bid Form including this Bidder Affirmation and Disclosure form and have read and understand that this form is a part of any Contract that Bidder may enter into with the State and is incorporated therein.

EDGE Program Commitment to Participate

Option A

The Bidder commits to meet or exceed the advertised EDGE Participation Goal of the Contract award amount, calculated as a portion of the Base Bid plus all accepted Alternates, by using EDGE-certified Business(es).

The Bidder agrees that if selected for consideration of the Contract, it shall provide (if not provided with the Bidder's Bid) to the Contracting Authority, at the location required and within 3 business days after receiving notice from the Contracting Authority, its fully completed Bidder's Qualification Form, including an EDGE Affidavit form for each EDGE-certified Business proposed for use by the Bidder if awarded the Contract for this Project.

Option B (indicate percentage of participation below)

The Bidder declares that it does not meet the advertised EDGE Participation Goal percentage, but, if awarded the Contract for this Project, commits to provide the percentage of the Contract award amount, indicated above, calculated as a portion of the Base Bid plus all accepted Alternates, by using EDGE-certified Business(es).

The Bidder acknowledges it understands the requirement for it to provide and agrees to provide to the Contracting Authority, if selected for consideration of the Contract, within 3 business days after notice from the Contracting Authority, a detailed Demonstration of Good Faith form describing its efforts undertaken prior to submitting its Bid to meet the advertised EDGE Participation Goal percentage for the Contract for this Project.

The Bidder commits to provide to the Contracting Authority at the location required, and within 3 days after receiving notice from the Contracting Authority, its fully completed Bidder's Qualifications Form, including an EDGE Affidavit form for each EDGE-certified Business proposed for use by the Bidder if awarded the Contract for this Project.

Option C

The Bidder declares that the Bidder is an EDGE-certified Business and that if awarded this Contract, the EDGE Participation percentage will be 100 percent of the Contract award amount.

Select EDGE option above*

Choices…

If option B selected, enter percentage

Certifications (State Prevailing Wages)

1. The Bidder has read and understands the proposed Contract Documents and agrees to comply with all requirements of the proposed Contract Documents, regardless of whether the Bidder has actual knowledge of the requirements and regardless of any statement or omission made by the Bidder, which might indicate a contrary intention.

2. The Bidder represents that the Bid is based upon the Basis of Design and Acceptable Components specified by the proposed Contract Documents.

3. The Bidder has visited the Site, become familiar with local conditions, and has correlated personal observations about the requirements of the proposed Contract Documents. The Bidder has no outstanding questions regarding the interpretation or clarification of the proposed Contract Documents.

4. The Bidder understands that the execution of the Project will require sequential, coordinated, and interrelated operations, which may involve interference, disruption, hindrance, or delay in the progress of the Bidder's Work. The Bidder agrees that the Contract Sum, as amended from time to time, shall cover all amounts due from the State resulting from interference, disruption, hindrance, or delay that is not caused by the State or its agents and employees. The Bidder agrees that any such interference, disruption, hindrance, or delay is within the contemplation of the Bidder and the State and that the Contractor's sole remedy from the State for any such interference, disruption, hindrance, or delay shall be an extension of time in accordance with the proposed Contract Documents.

5. The Bidder and each Person submitting a Bid on behalf of the Bidder certifies, and in the case of a Bid by a joint venture each member thereof certifies as to such member's entity, under penalty of perjury, that to the best of the undersigned's knowledge and belief: (a) the Base Bid, any Unit Prices, and any Alternate bid in the Bid have been arrived at independently without collusion, consultation, communication or agreement, for the purpose of restricting competition as to any matter relating to such Base Bid, Unit Prices or Alternate bid with any other Bidder; (b) unless otherwise required by law, the Base Bid, any Unit Prices and any Alternate bid in the Bid have not been knowingly disclosed by the Bidder and shall not knowingly be disclosed by the Bidder prior to the bid opening, directly or indirectly, to any other Bidder who would have any interest in the Base Bid, Unit Prices, or Alternate bid; (c) no attempt has been made or shall be made by the Bidder to induce any other Person to submit or not to submit a Bid for the purpose of restricting competition.

6. The Bidder shall execute the Agreement with the Contracting Authority, if a Contract is awarded on the basis of this Bid, and if the Bidder does not execute the Agreement for any reason, other than as authorized by law, the Bidder and the Bidder's Surety are liable to the State as provided in Article 5 of the Instructions to Bidders.

7. The Bidder certifies that the upon the award of a Contract, as the Contractor it shall make a good faith effort to ensure that all of the Contractor's employees, while working on the Site, shall not purchase, transfer, use, or possess illegal drugs or alcohol or abuse prescription drugs in any way.

8. The Bidder acknowledges that it read all of the Instructions to Bidders, and in particular, Section 2.10 - Submittals With Bid Form, and by submitting its Bid certifies that it has read the Instructions to Bidders and it understands and agrees to the terms and conditions stated in them.

9. The Bidder agrees to furnish any information requested by the Contracting Authority or the Architect/Engineer to evaluate the responsibility of the Bidder.

10. The Bidder agrees to furnish the submittals required by Section 6.1 of the Instructions to Bidders for execution of the Agreement within 10 days of the date of the Notice of Intent to Award.

11. When the Bidder is a corporation, partnership or sole proprietorship, an officer, partner or principal of the Bidder, as applicable, shall enter the legal name of the Bidder and the name of the officer, partner or principal of the Bidder (in lieu of signing the Bid Form) in the data fields provided.

12. When the Bidder is a joint venture, an officer, partner or principal, as applicable, of each member of the joint venture shall enter the legal name of the applicable member and the name of the officer, partner or principal (in lieu of signing the Bid Form) in the data fields provided.

13. The Bidder understands that the Contract is subject to all the provisions, duties, obligations, remedies and penalties of Ohio Revised Code Chapter 4115 and that the Bidder shall pay any wage increase in the locality during the term of the Contract.

14. The Bidder represents that the individual that is submitting and digitally signing the electronic Bid is legally authorized to do so.

15. Bidder acknowledges that by the act of submitting an electronic Bid that it is digitally signing the actual Bid, which shall serve as the Bidder's authorization for the further consideration and activity in the bidding and contract process.

☐ The Bidder hereby acknowledges that the above representations in this Bid are material and not mere recitals.*

◘ Certifications (Federal Prevailing Wages)

1. The Bidder has read and understands the proposed Contract Documents and agrees to comply with all requirements of the proposed Contract Documents, regardless of whether the Bidder has actual knowledge of the requirements and regardless of any statement or omission made by the Bidder, which might indicate a contrary intention.

2. The Bidder represents that the Bid is based upon the Basis of Design and Acceptable Components specified by the proposed Contract Documents.

3. The Bidder has visited the Site, become familiar with local conditions, and has correlated personal observations about the requirements of the proposed Contract Documents. The Bidder has no outstanding questions regarding the interpretation or clarification of the proposed Contract Documents.

4. The Bidder understands that the execution of the Project will require sequential, coordinated, and interrelated operations, which may involve interference, disruption, hindrance, or delay in the progress of the Bidder's Work. The Bidder agrees that the Contract Sum, as amended from time to time, shall cover all amounts due from the State resulting from interference, disruption, hindrance, or delay that is not caused by the State or its agents and employees. The Bidder agrees that any such interference, disruption, hindrance, or delay is within the contemplation of the Bidder and the State and that the Contractor's sole remedy from the State for any such interference, disruption, hindrance, or delay shall be an extension of time in accordance with the proposed Contract Documents.

5. The Bidder and each Person submitting a Bid on behalf of the Bidder certifies, and in the case of a Bid by a joint venture each member thereof certifies as to such member's entity, under penalty of perjury, that to the best of the undersigned's knowledge and belief: (a) the Base Bid, any Unit Prices, and any Alternate bid in the Bid have been arrived at independently without collusion, consultation, communication or agreement, for the purpose of restricting competition as to any matter relating to such Base Bid, Unit Prices or Alternate bid with any other Bidder; (b) unless otherwise required by law, the Base Bid, any Unit Prices and any Alternate bid in the Bid have not been knowingly disclosed by the Bidder and shall not knowingly be disclosed by the Bidder prior to the bid opening, directly or indirectly, to any other Bidder who would have any interest in the Base Bid, Unit Prices, or Alternate bid; (c) no attempt has been made or shall be made by the Bidder to induce any other Person to submit or not to submit a Bid for the purpose of restricting competition.

6. The Bidder shall execute the Agreement with the Contracting Authority, if a Contract is awarded on the basis of this Bid, and if the Bidder does not execute the Agreement for any reason, other than as authorized by law, the Bidder and the Bidder's Surety are liable to the State as provided in Article 5 of the Instructions to Bidders.

7. The Bidder certifies that the upon the award of a Contract, as the Contractor it shall make a good faith effort to ensure that all of the Contractor's employees, while working on the Site, shall not purchase, transfer, use, or possess illegal drugs or alcohol or abuse prescription drugs in any way.

8. The Bidder acknowledges that it read all of the Instructions to Bidders, and in particular, Section 2.10 - Submittals With Bid Form, and by submitting its Bid certifies that it has read the Instructions to Bidders and it understands and agrees to the terms and conditions stated in them.

9. The Bidder agrees to furnish any information requested by the Contracting Authority or the Architect/Engineer to evaluate the responsibility of the Bidder.

10. The Bidder agrees to furnish the submittals required by Section 6.1 of the Instructions to Bidders for execution of the Agreement within 10 days of the date of the Notice of Intent to Award.

11. When the Bidder is a corporation, partnership or sole proprietorship, an officer, partner or principal of the Bidder, as applicable, shall enter the legal name of the Bidder and the name of the officer, partner or principal of the Bidder (in lieu of signing the Bid Form) in the data fields provided.

12. When the Bidder is a joint venture, an officer, partner or principal, as applicable, of each member of the joint venture shall enter the legal name of the applicable member and the name of the officer, partner or principal (in lieu of signing the Bid Form) in the data fields provided.

13. The Bidder understands that the Contract is subject to all the provisions, duties, obligations, remedies and penalties of the Davis Bacon Act, 40 United States Code Section 3141 and following, and that the Bidder shall pay any wage increase in the locality during the term of the Contract. Federal Prevailing Wage rates may be subject to change prior to the final award of this Contract.

14. The Bidder represents that the individual that is submitting and digitally signing the electronic Bid is legally authorized to do so.

15. Bidder acknowledges that by the act of submitting an electronic Bid that it is digitally signing the actual Bid, which shall serve as the Bidder's authorization for the further consideration and activity in the bidding and contract process.

☐ The Bidder hereby acknowledges that the above representations in this Bid are material and not mere recitals.*

Procurement Forms

Document 00 43 13 - Bid Security Form
→ Upload below and provide original document within 3 days

Document 00 45 13 - Bidder's Qualifications
→ Upload below or provide within 3 days of request

Document 00 45 39 - EDGE Affidavit
→ Upload below or provide within 3 days of request

3 Attachments

Instructions for Providing Bid Submittals

Submission of Electronic Facsimile of Bid Guaranty with Electronic Bid

The Bidder shall upload and attach to its bid an electronic facsimile (scanned PDF document) of its bid guaranty, payable to the Contracting Authority, in the form of any of the following: (1) the signed and sealed Document 00 43 13 - “Bid Security Form” contained in the Contract Documents (and provided for the Bidder's convenience in the block above) for the amount of the Base Bid plus all additive Alternates; or (2) a certified check, cashier's check, or letter of credit, for 10 percent of the Base Bid, plus all additive Alternates – a letter of credit shall expressly provide that it is revocable only by the Contracting Authority (refer to Sections 2.10.1.1 and 5.1 of Document 00 21 13 - "Instructions to Bidders"); or (3) an electronic verification through an electronic verification and security system.

Submission of Original Bid Guaranty

In addition to the electronic facsimile above, if not using an electronic verification and security system, the Bidder shall deliver its original unaltered Bid Guaranty to the Project Coordinator at the address identified below within 3 business days after the bid deadline. Refer to Section 2.10.1.2 of the Instructions to Bidders.

«enter Project Coordinator's name»
Project Coordinator
«enter Contracting Authority's name»
«enter Contracting Authority's address»
«enter Contracting Authority's city, state, and zip code»

Non-responsive Bid for Failure to Submit Bid Guaranty

If not using an electronic verification and security system, the Bidder must submit both the electronic facsimile and the original unaltered Bid Guaranty as described above. The Contracting Authority shall reject a Bid as non-responsive if the Bidder fails to submit both elements of the Bid Guaranty. The checkboxes below are to identify that you have uploaded an acceptable form of Bid Guaranty. Do not check all boxes. Refer to Section 2.10.1 of the Instructions to Bidders.

Submission of Bidder's Qualifications and EDGE Affidavit

The Bidder is encouraged to submit background information with its Bid using Document 00 45 13 - "Bidder's Qualifications" and Document 00 45 39 - "EDGE Affidavit" with the EDGE-certified Business(es) the Bidder proposes to use on the Project (forms provided for the Bidder's convenience in the block above). If the Bidder does not submit the Bidder's Qualifications form and/or the EDGE Affidavit form and related information attached to the electronic Bid Form, the Bidder shall provide it within 3 days of request. Refer to Sections 2.10.3 and 3.5.4 of the Instructions to Bidders.

Required Bid Guaranty Upload

Name	File*
Document 00 43 13 - Bid Security Form → Upload a scan of the fully executed Bid Security Form AND submit the original document to the Contracting Authority within 3 days of the bid deadline	Select file... no file selected ☐ I am NOT enclosing this document because the omission terms have been met. (Bidder submitted a Cashier's Check OR Electronic Verification below)
Power of Attorney → Upload a scan of the fully executed Power of Attorney AND submit the original document to the Contracting Authority within 3 days of the bid deadline	Select file... no file selected ☐ I am NOT enclosing this document because the omission terms have been met. (Bidder submitted a Cashier's Check OR Electronic Verification below OR included with the Bid Security Form above)
Cashier's Check for 10% of the Bid → Upload a scan of the Cashier's Check AND submit the original check to the Contracting Authority within 3 days of the bid deadline	Select file... no file selected ☐ I am NOT enclosing this document because the omission terms have been met. (Bidder submitted the Bid Security Form AND Power of Attorney above, OR Electronic Verification below)
Electronic Verification and Security System → Upload a secure authorization code uniquely and electronically assigned to the Bid Guaranty and Power of Attorney	Select file... no file selected ☐ I am NOT enclosing this document because the omission terms have been met. (Bidder submitted a Bid Security Form AND Power of Attorney, OR Cashier's Check above)

4 Required Documents

Bidder's Qualifications and EDGE Affidavit Upload

Name	File*
Document 00 45 13 - Bidder's Qualifications → Upload fully completed form and attachments	Select file... no file selected ☐ I am NOT enclosing this document because the omission terms have been met. (Must be submitted to the Contracting Authority within 3 days of request)

Document 00 45 39 - EDGE Affidavit → Upload a completed form for each EDGE business	Select file... no file selected ☐ I am NOT enclosing this document because the omission terms have been met. (Must be submitted to the Contracting Authority within 3 days of request)
2 Required Documents	

Bidder Signatory Information

Bidder Signatory

Name of Bidder's Authorized Signatory:*

Title of Authorized Signatory:*

All Bidders complete all information in this form. Duplicate and complete the block below for each Joint Venturer:

Bidder Information

Business Name:*

Business Mailing Address, City, State, Zip:*

Telephone Number:*

Email Address:*

Federal Tax ID Number:*

State of Incorporation (if applicable):

Contact person for Contract processing:*

Date enrolled in an OBWC-approved SUPR (month/date/year):

President or Chief Executive Officer's Name:*

President or Chief Executive Officer's Title:*

END OF DOCUMENT

Document 00 43 13 - Bid Security Form
State of Ohio Standard Requirements for Public Facility Construction

(Form of combined Bid Guaranty and Bond prescribed by Ohio Revised Code Section 153.571)

KNOW ALL PERSONS BY THESE PRESENTS, that we, the undersigned _____

_____, as Principal,

and _____ as Sureties,

are hereby held and firmly bound unto _____

_____ as Obligee(s), in the penal sum of the dollar amount of the Bid submitted by the Principal

to the Obligee on _____ (date) to undertake the Project known as:

Project Number: _____

Project Name: _____

Contract Description: _____
(e.g., General Contractor/Trades, Plumbing, HVAC, Electrical)

The penal sum, referred to herein, shall be the dollar amount of the Principal's Bid to the Obligee, incorporating any additive alternate Bids made by the Principal on the date referred to above to the Obligee, which are accepted by the Obligee. In no case shall the penal sum exceed the amount of dollars ($_____). (If the preceding line is left blank, the penal sum will be the full amount of the Principal's Bid, including add alternates. Alternatively, if completed, the amount stated shall not be less than the full amount of the Bid, including Alternates, in dollars and cents. A percentage is not acceptable.) For the payment of the penal sum well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that whereas the above-named Principal has submitted a Bid for the above referenced Project;

NOW, THEREFORE, if the Obligee accepts the Bid of the Principal, and the Principal fails to enter into a proper contract in accordance with the Bid, Plans, Specifications, details, and bills of material; and in the event the Principal pays to the Obligee the difference, not to exceed ten percent of the penal sum hereof between the amount specified in the Bid and such larger amount for which the Obligee may in good faith contract with the Bidder determined by the Obligee to be the next lowest responsive and responsible to perform the Work covered by the Bid; or in the event the Obligee does not award the Contract to such next lowest responsive and responsible Bidder and resubmits the Project for bidding, the Principal pays to the Obligee the difference not to exceed ten percent of the penal sum hereof between the amount specified in the Bid, or the costs, in connection with the resubmission, of printing new Contract Documents, required advertising and printing and mailing notices to prospective Bidders, whichever is less, then this obligation shall be null and void, otherwise to remain in full force and effect. If the Obligee accepts the Bid of the Principal, and the Principal, within 10 days after the awarding of the Contract, enters into a proper contract and executes the Agreement Form in accordance with the Contract Documents, including without limitation the Bid, Plans, Specifications, details, and bills of material, which said Contract is made a part of this Bond the same as though set forth herein; and

NOW ALSO, IF THE SAID Principal shall well and faithfully perform each and every condition of such Contract; and indemnify the Obligee against all damage suffered by failure to perform such Contract according to the provisions thereof and in accordance with the Contract Documents, including without limitation Plans, Specifications, details, and bills of material therefore; and shall pay all lawful claims of Subcontractors, Material Suppliers and laborers for labor performed and materials furnished in the carrying forward, performing or completing of said Contract; we, agreeing and assenting that this undertaking shall be for the benefit of any Subcontractor, Material Suppliers or laborer having a just claim, as well as for the Obligee herein; then this obligation shall be void; otherwise the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

THE SAID Surety hereby stipulates and agrees that no modifications, omissions or additions, in or to the terms of said Contract, the Work thereunder or the Contract Documents, including without limitation the Plans and Specifications, therefore, shall in any way affect the obligations of said Surety on its bond, and it does hereby waive notice of any such modifications, omissions or additions in or to the terms of the Contract, the Work, or the Contract Documents, including without limitation the Plans and Specifications.

SIGNED AND SEALED this _____ day of _____ , _____ .

PRINCIPAL:

_____
Signature

By: _____
Name

_____
Title

SURETY:

_____
Signature

By: _____
Attorney-in-Fact

SURETY INFORMATION:

_____
Name

_____
Address 1

_____
Address 2

_____
City State Zip

_____
Telephone

_____
Email

SURETY AGENT'S INFORMATION:

_____
Name

_____
Address 1

_____
Address 2

_____
City State Zip

_____
Telephone

_____
Email

END OF DOCUMENT

Document 00 45 13 - Bidder's Qualifications
State of Ohio Standard Requirements for Public Facility Construction

Project Number: _____

Project Name: _____

1. **Company Name**: _____

   Physical Address: _____
   Street, Building, Unit

   _____
   City, State, Zip

   Mailing Address (if different): _____
   P.O. Box

   _____
   City, State, Zip

   Telephone Number (w/ Area Code): (_____) _____

   Fax Number (w/ Area Code): (_____) _____

   Email address: _____

2. **Overall Experience.** Indicate Bidder's overall experience performing the trades bid, including the years in business performing the trade under present and former business names.

3. **Financial.** The apparent low Bidder shall submit, upon request of the Contracting Authority, either:

   a) An annual financial statement prepared within the 12 months prior to the bid opening by an independent licensed accounting firm; and the name, address, contact person and phone number of the bank normally used by the Bidder for its primary banking; or,

   b) A financial report generated within 30 days prior to the bid opening from Standard and Poor, Dun and Bradstreet or a similar company acceptable to the Contracting Authority documenting the financial condition of the Bidder; and the name, address, contact person and phone number of the bank normally used by the Bidder for its primary banking;

   This information is not a public record under Ohio Revised Code Section 149.43; and shall remain confidential, except under proper order of a court.

4. **Facilities & Equipment**. Indicate Bidder's relevant facilities and major equipment (leased or owned).

5. **Ongoing & Relevant Projects.** List all ongoing projects and projects completed in the last 5 years, which are similar in cost and type to the Project. Include scope of Work, Contract value, a description of EDGE participation and performance, and project name/contact person/address/phone number for each owner and the architect or engineer for each project.

6. **Regulatory / Contractual.** Indicate all occurrences of the following in the last 5 years (indicate if none). For verification, attach documentation, and/or provide sufficient and appropriate detail information such as: project name, owner, contact person and phone number, amount of contract, etc.

    a) State or federal Prevailing Wage violations or judgments

    b) Affirmative Action and EDGE program violations (Attach Certificate of Compliance with Affirmative Action Programs, issued pursuant to Ohio Revised Code Section 9.47)

    c) Contract abandonment, contract termination, as either a prime- or sub-contractor, or Surety takeover

    d) Debarment by state, federal, or local jurisdictions

e) EPA/OSHA violations

f) Liquidated damages and Statutory Delay Forfeiture assessed

g) Drug-Free Safety Program and Drug Free Workplace Program violations

7. Management. Identify individuals assigned to this Project.

Principal _____ Years with firm _____ Total Exp._____

Project Manager _____ Years with firm _____ Total Exp._____

Field Superintendent _____ Years with firm _____ Total Exp._____

8. EDGE Participation. Identify EDGE-certified Business Enterprises proposed as Subcontractors and Material Suppliers for this Project. Attach a fully completed Document 00 45 39 - "EDGE Affidavit" for each EDGE-certified Business Enterprise.

9. Certification. I hereby certify that the information in this entire Bidder's Qualifications form, including all attachments and referenced information, is factual and complete.

Company Name _____

Authorized Official (please print or type) _____

Signature of Authorized Official _____ Date _____

END OF DOCUMENT

Document 00 45 39 - EDGE Affidavit
State of Ohio Standard Requirements for Public Facility Construction

EDGE PARTICIPATION

Certified Statement of Intent to Contract and Perform

Bidder or Proposer: Submit one fully completed form for each EDGE-certified Business

Project: _____

Project Name: _____

A. Bidder or Proposer's Company Name: _____

Mark all that apply:

__ Multi-Prime Contract __ General Contract __ CM at Risk Contract __ Design-Build Contract

B. EDGE-certified Business information (for contract at ANY tier)

Mark all that apply:

__ Subcontractor __ Material Supplier __ Professional Services __ Goods & Services

EDGE Business Name: _____

EDGE Business Address: _____

_____

EDGE Certification Number: _____ E-mail: _____

Contact Person: _____ Phone: _____

Insert detailed description of materials, labor, services, supplies, etc. (may use industry codes – continue on separate page):

_____

_____

_____

C. Certification of Intent

By signing below, the Bidder or Proposer certifies that it intends to contract with the EDGE-certified Business for the portion of the contract described above related to its Contract for this Project and for the estimated cost shown below. By signing below, the EDGE-certified Business certifies that it intends to contract with the Bidder or Proposer and intends to provide the portion of the contract described above related to the Contract for this Project for the estimated cost of:

_____ and _____ /100 dollars ($_____).

In the event the named Bidder or Proposer is NOT awarded a Contract, this Statement shall be null and void.

EDGE-certified Business	***Bidder or Proposer***
_____	_____
Authorized Signature	Authorized Signature
_____	_____
Name and Title	Name and Title
_____	_____
Date Signed	Date Signed

END OF DOCUMENT

Document 00 52 00 - Agreement Form (University Project)
State of Ohio Standard Requirements for Public Facility Construction

This Agreement is made as of the date set forth below between the State of Ohio, acting by and through the University, and the Contractor in connection with the Project.

Project Number:	**WSU-231035**
Project Name:	**Lake Campus Workforce Development Project**
Site Address:	7600 Lake Campus Drive Celina, Ohio 45822 Mercer County
Owner ("University"):	**Wright State University**
Owner's Representative:	Daniel Papay, P.E., University Engineer
Address:	3640 Colonel Glenn Highway Dayton, Ohio 45435
Contracting Authority:	The University above
Project Manager:	
Contractor:	**«insert name»**
Contractor's Principal Contact:	«insert name»
Address:	«insert street address» «insert city, state zip code»
Architect/Engineer ("A/E"):	**Fanning/Howey Associates, Inc.**
A/E's Principal Contact:	Rodney D. Wiford
Address:	128 West Market Street Celina, Ohio 45822

ARTICLE 1 - SCOPE OF WORK; EDGE COMMITMENT

1.1 The Contractor shall perform and provide all of the Work described in the Contract. The Work is allocated to the below-identified Phases.

Phase	Scope of Work
«insert Phase name»	«insert Phase description»
«insert Phase name»	«insert Phase description»
«insert Phase name»	«insert Phase description»
«insert Phase name»	«insert Phase description»

1.2 The project delivery method for this Project shall be General Contracting.

1.3 The Contractor shall contract with EDGE-certified Business(es) for not less than «insert Contractor's EDGE commitment» percent of the Contract Sum.

ARTICLE 2 - COMPENSATION

2.1 The University shall pay the Contractor the Contract Sum for the Contractor's proper, timely, and complete performance of the Contract. The Contract Sum is **$«insert amount»**, subject to Modifications as provided in the Contract Documents. The Contract Sum is comprised of the following:

2.1.1 Base Bid: .....$«Insert Base Bid Amount»

2.1.2 Alternate «Insert Alternates Awarded»: .....$«Insert Alternate Amount»

2.1.3 Alternate «Insert Alternates Awarded»: .....$«Insert Alternate Amount»

2.1.4 Alternate «Insert Alternates Awarded»: .....$«Insert Alternate Amount»

2.1.5 Alternate «Insert Alternates Awarded»: .....$«Insert Alternate Amount»

2.2 The funding for the Project, including funds retained from payments to the Contractor, will not accrue interest for the benefit of the Project or the Contractor.

ARTICLE 3 - CONTRACT TIMES

3.1 The Contract Times are the periods established in the following table for the achievement of the associated Milestones:

Construction Stage Milestone(s) to which Liquidated Damages apply	**Contract Time**	**Projected Date** (as of the date of this Agreement)
«insert description of interim milestone – add more rows if necessary – delete if none»	«insert number of calendar days» days	«insert date»
Substantial Completion of all Work	«insert number of calendar days» days	«insert date»

3.1.1 The projected dates listed under "Projected Date (as of the date of this Agreement)" are **(1)** based upon an anticipated, but not guaranteed, Date of Commencement of «insert date»; and **(2)** provided only for convenient reference during consideration of the Agreement. The durations listed under "Contract Time" define the Contract Times and take precedence over the projected dates.

ARTICLE 4 - KEY PERSONNEL

4.1 The Contractor's key personnel for the Project are:

4.1.1 «insert name», Project Manager;

4.1.2 «insert name», Lead Scheduling Engineer;

4.1.3 «insert name», General Superintendent.

4.2 The Contractor's key personnel are authorized to act on the Contractor's behalf with respect to the Project and all matters concerning the Project.

ARTICLE 5 - GENERAL PROVISIONS

5.1 Effectiveness.

5.1.1 It is expressly understood by the Contractor that none of the rights, duties, and obligations described in the Contract Documents shall be valid and enforceable unless the Director of the Office of Budget and Management first certifies that there is a balance in the University's appropriation not already encumbered to pay existing obligations and until all relevant statutory provisions of the Ohio Revised Code, including ORC Section 126.07, have been complied with, and until such time as all necessary funds are available or encumbered and, when required, such expenditure of such funds is approved by the State Controlling Board, or other applicable approving body.

5.1.2 In addition, if federal funds are to be used to pay fees and expenses under this Agreement, none of the rights, duties, and obligations contained in this Agreement shall be binding on any party until the University gives the Contractor written notice that such funds are available from the University's funding source.

5.1.3 Subject to **Section 5.1.1**, the Contract shall become binding and effective upon execution by the University, Contractor, and if the total estimated Project cost is $250,000 or more, upon approval of the Ohio Attorney General.

5.1.3.1 If the Contractor is a joint venture, **(1)** each individual joint venturer shall **(a)** sign the Agreement in its own name and **(b)** be a party to the Contract, and **(2)** the Contract and the Performance and Payment Bond shall be binding on and apply to all joint venturers jointly and severally.

5.1.3.2 If the Contractor is a limited liability company, which the Contracting Authority reasonably believes to be a special purpose or similar entity, the Contracting Authority may in its discretion require the limited liability company and each member of the limited liability company to **(1)** sign the Agreement in its own name and **(2)** be a party to the Contract. In that case, the Contract and the Performance and Payment Bond shall be binding on and apply to the limited liability company and to all of its members jointly and severally.

5.1.4 This Agreement may be executed in several counterparts, each of which shall constitute a complete original Agreement, which may be introduced in evidence or used for any other purpose without production of any other counterparts.

5.2 Representations.

5.2.1 The Contractor represents and warrants that it is not subject to an unresolved finding for recovery under ORC Section 9.24. If this representation and warranty is found to be false, the Contract is void, and the Contractor shall immediately repay to the University any funds paid under this Contract.

5.2.2 The Contractor hereby certifies that neither the Contractor nor any of the Contractor's partners, officers, directors, shareholders nor the spouses of any such person have made contributions in excess of the limitations specified in ORC Section 3517.13.

5.2.3 The Contractor, by signature on this Agreement, certifies that it is currently in compliance with, and will continue to adhere to, the requirements of Ohio ethics laws and conflict of interest laws and will take no action inconsistent with those laws.

5.2.4 The Contractor affirms to have read and understands Executive Order 2019-12D and shall abide by those requirements in the performance of this Contract. Notwithstanding any other terms of this Contract, the State reserves the right to recover any funds paid for services the Contractor performs outside of the United States for which it did not receive a waiver. The State does not waive any other rights and remedies provided the State in this Contract.

5.2.5 The Contractor affirms to have read and understands Executive Order 2022-02D regarding the prohibition of purchases from or investment in a Russian institution or company and shall abide by those requirements in the performance of this Contract. Notwithstanding any other terms of this Contract, the State reserves the right to recover any funds paid to the Contractor for purchases or investments in a Russian institution or company in violation of this paragraph. The provisions of this paragraph will expire when the applicable Executive Order is no longer effective.

5.2.6 During the performance of this Contract, if the Contractor changes the location(s) disclosed on the **Affirmation and Disclosure Form** (a page in its **Bid Form**), the Contractor must complete and submit a revised **Affirmation and Disclosure Form**.

5.2.7 Pursuant to ORC Section 9.76(B), the Contractor warrants that it is not boycotting any jurisdiction with whom the State of Ohio can enjoy open trade, including Israel, and will not do so during the term of this Contract.

5.2.8 All non-residential contractors, subcontractors, and labor brokers shall comply with the E-Verify Workforce Integrity Act's requirements as set forth in sections 4151.02 and 4151.03 of the Revised Code.

ARTICLE 6 - Enumeration of Documents

6.1 The Contract Documents constitute the substance of the Contract, and include this Agreement, Drawings, Specifications, Addenda if any, **Contracting Definitions**, **General Conditions**, Supplementary Conditions if any, **Bid Form**, **Wage Rate Requirements**, **Bid Guaranty and Contract Bond** or **Performance and Payment Bond**, and Change Orders if any.

SIGNATURES

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the date set forth below:

«INSERT CONTRACTOR'S NAME»	**OWNER**
_____	_____
Signature	*Signature*
_____	_____
Printed Name	*Printed Name*
_____	_____
Title	*Title*

OHIO ATTORNEY GENERAL
Approval as to Form

_____
Signature

_____
Printed Name

_____
Title

_____
Date

«INSERT CONTRACTOR'S NAME»
by «insert Joint Venturer/Member's name»

_____
Signature

_____
Printed Name

_____
Title

OWNER

_____
Signature

_____
Printed Name

_____
Title

by «insert Joint Venturer/Member's name»

_____
Signature

_____
Printed Name

_____
Title

OHIO ATTORNEY GENERAL
Approval as to Form

_____
Signature

_____
Printed Name

_____
Title

_____
Date

END OF DOCUMENT

Document 00 52 14 - State of Ohio Subcontract Form
State of Ohio Standard Requirements for Public Facility Construction

This Agreement is made as of the date set forth below between the Contractor and the Subcontractor in connection with the Project.

Project Number:	**WSU-231035**
Project Name:	**Lake Campus Workforce Development Project**
Site Address:	«7600 Lake Campus Drive» «Celina, Mercer County»
Contractor:	**«insert name»**
Contractor's Principal Contact:	«insert name»
Address:	«insert street address» «insert city, state zip code»
Subcontractor:	**«insert name»**
Subcontractor's Principal Contact:	«insert name»
Address:	«insert street address» «insert city, state zip code»
Public Authority:	**«Wright State University»**
Public Authority Contact:	« »
Address:	«» «»

ARTICLE 1 - NATURE OF SUBCONTRACT

1.1 The Subcontractor shall perform the entire Subcontract Work as specified in Exhibit «N» and described in the Contract Documents for the Project.

ARTICLE 2 - COMPENSATION

2.1 The Contractor agrees to pay for the performance of this Subcontract, subject to additions and deductions as provided in the Contract Documents, the Subcontract Sum of «insert Subcontract Sum», comprised of the following:

«insert Subcontract Sum component» ..... $«insert amount»

«insert Subcontract Sum component» ..... $«insert amount»

«insert Subcontract Sum component» ..... $«insert amount»

«insert Subcontract Sum component» ..... $«insert amount»

ARTICLE 3 - TIME OF PERFORMANCE

3.1 Time is of the essence. The Subcontractor shall diligently prosecute and complete all Subcontract Work in accordance with the construction progress schedule agreed between the parties.

ARTICLE 4 - CONTRACT DOCUMENTS

4.1 To the extent that the contract between the Public Authority and the Contractor applies to the Subcontract Work:

4.1.1 The Contractor and the Subcontractor agree to be mutually bound by the terms of the Contract Documents;

4.1.2 The Contractor assumes toward the Subcontractor the rights, remedies, obligations, and responsibilities that the Public Authority has and assumes toward the Contractor;

4.1.3 The Subcontractor assumes toward the Contractor the rights, remedies, obligations, and responsibilities that the Contractor assumes toward the Public Authority; and

4.1.4 The Subcontractor agrees to perform its portion of the Work in accordance with the Contract Documents.

4.2 The Subcontract and any modifications, amendments, or alterations thereto shall be governed, construed, and enforced by and under the laws of the State of Ohio.

4.3 If any term or provision of the Subcontract, or the application thereof to any Person or circumstance, is finally determined, to be invalid or unenforceable by a court of competent jurisdiction, the remainder of the Subcontract or the application of such term or provision to other Persons or circumstances, shall not be affected thereby, and each term and provision of the Subcontract shall be valid and enforced to the fullest extent permitted by law.

4.4 The Subcontract shall be binding on the Contractor and Subcontractor, their successors and assigns, in respect to all respective covenants and obligations contained in the Contract Documents, but the Subcontractor may not assign the Subcontract without the prior written consent of the Contractor and the Public Authority.

ARTICLE 5 - EFFECTIVENESS

5.1 The Subcontract shall become binding and effective upon execution by the Contractor.

5.2 This Subcontract has been executed in several counterparts, each of which shall constitute a complete original Subcontract, which may be introduced in evidence or used for any other purpose without production of any other counterparts.

5.3 Any signatory may deliver a copy of its counterpart signature page to this Subcontract via fax or e-mail. Each signatory shall be entitled to rely upon a signature of any other signatory delivered in such a manner as if such signature were an original.

ARTICLE 6 - REPRESENTATIONS

6.1 Contingent Assignment. The Contractor's contingent assignment of this Subcontract to the Public Authority, as provided in the Contract, is effective after termination of the Contractor by the Public Authority and the Public Authority's acceptance of the assignment in writing to the Subcontractor. The Subcontractor consents to the assignment and shall be bound at the same price and terms as in the Subcontract to the Public Authority. Unless the Public Authority takes assignment of the Subcontract, the Subcontractor will not have any contractual rights against the Public Authority.

6.2 Intended Third-Party Beneficiary. The Public Authority is an intended third party beneficiary of the Subcontract, entitled to enforce any rights thereunder for its benefit.

6.3 Insurance. The Subcontractor shall maintain insurance in accordance with the Contract Documents. Exhibit «N» sets forth the minimum limits of liability for the insurance required in the Contract Documents.

6.4 Right to Audit. The Subcontractor agrees that the Public Authority or any agents designated by the Public Authority have access to and the right to audit and the right to copy at the Public Authority's cost all of the Subcontractor's books, records, contracts, correspondence, instructions, drawings, receipts, vouchers, purchase orders, and memoranda relating to the Work for a period of not less than 3 years following completion of the Work consistent with Ohio Revised Code ("ORC") Section 149.43 with regard to the Public Authority's obligation to maintain confidentiality of trade secrets.

6.5 Indemnity. To the fullest extent permitted by law, the Subcontractor shall indemnify, defend, and hold harmless the Public Authority, the Contractor, their consultants and employees from all claims and expenses for bodily injury and property damage other than to the Work itself that may arise from the performance of the Subcontract Work, including reasonable attorneys' fees, costs and expenses, but only to the extent caused by the negligent acts or omissions of the Subcontractor or a person or entity for whom the Subcontractor may be liable. This Subcontract does not require a Subcontractor to waive its immunity under the Workers Compensation laws of Ohio from claims brought against the Subcontractor by the Subcontractor's employees.

6.6 Prompt Pay. The Contractor shall at a minimum make payments to the Subcontractor in accordance with Applicable Law, including ORC Section 4113.61. Progress payments to the Subcontractor for satisfactory performance of Subcontract Work shall be made no later than 10 days after receipt by the Contractor of payment from the Public Authority for Subcontract Work.

6.7 Retainage. Subcontractor retainage shall be at a rate equal to the percentage retained from the Contractor's payment by the Public Authority for the Subcontract Work, unless a lesser percentage is otherwise specified.

6.7.1 Labor Payments.

6.7.1.1 Partial payments to the Subcontractor for labor performed shall be made at the rate of 92 percent of the amount invoiced through the Subcontractor's request for payment that shows the Work of the Subcontractor is 50 percent complete.

6.7.1.2 After the Work of the Subcontractor is 50 percent complete, as evidenced by payments of at least 50 percent of the total amount due under the Subcontract, no additional funds shall be retained from payments for labor.

6.7.2 Material Payments.

6.7.2.1 The Contractor shall pay the Subcontractor at the rate of 100 percent of the scheduled value for materials incorporated into the Project.

6.7.2.2 The Contractor shall pay the Subcontractor at the rate of 92 percent of the invoice cost, not to exceed the scheduled value, for materials delivered to the Site, or other off-site storage location approved by the A/E, provided the Subcontractor provides the following information with its request for payment:

.1 a list of the fabricated materials consigned to the Project, giving the place of storage, together with copies of invoices, in order to verify quantity and cost; and

.2 a certification of materials stored off-site, prepared by the Subcontractor and signed by the A/E to evidence that the materials are in conformity with the Specifications and have been tagged with the Project name and number for delivery to the Project. The Subcontractor shall reimburse the A/E, through the Contractor, for all costs incurred to visit a storage site, other than the areas adjacent to the Project.

.3 The Contractor shall pay the balance of the scheduled value when the materials are incorporated into and become a part of the Project.

6.8 Warranty. The Subcontractor fully warrants, for the benefit of the Public Authority, that all materials and equipment shall be new unless otherwise specified, of good quality, in conformance with the Contract Documents and free from defective workmanship or materials.

6.9 Non-Waiver of Lien Rights or Payment Bond Rights. This Subcontract shall not prohibit a Subcontractor from exercising its rights under ORC Chapter 1311 or under any Contractor-provided payment bond.

6.10 Non-Discrimination. The Subcontractor agrees to fully comply with Applicable Law regarding equal opportunity, including ORC Section 153.59 and, to the extent applicable, all Executive Orders issued by the Governor of the state of Ohio.

6.11 Dispute Resolution. The supplemental conditions to this Subcontract shall provide for a dispute resolution process comparable to the Contract's dispute resolution process in terms of timing, notice, substantiation, and informal dispute resolution efforts. The dispute resolution process provided in the supplemental conditions shall result in prompt access to the ultimate dispute resolution mechanism selected by the parties.

6.12 In the event that any supplemental conditions or other Subcontract terms conflict with the **State of Ohio Subcontract Form**, the **State of Ohio Subcontract Form** takes precedence and this Subcontract shall be read and enforced to include the provisions of the **State of Ohio Subcontract Form**.

6.13 The following exhibits are attached to and are a part of this Subcontract:

6.13.1 Exhibit A:

6.13.2 Exhibit B:

6.13.3 Exhibit C:

6.13.4 Exhibit D:

SIGNATURES

IN WITNESS WHEREOF, the parties have executed this Subcontract Form.

«INSERT SUBCONTRACTOR'S NAME»	«INSERT CONTRACTOR'S NAME»
Signature	*Signature*
Printed Name	*Printed Name*
Title	*Title*
	Date

END OF DOCUMENT

Document 00 61 13 - Performance and Payment Bond Form
State of Ohio Standard Requirements for Public Facility Construction

(Form of Bond prescribed by Ohio Revised Code Section 153.57 - Not to be used as Bid Guaranty)

KNOW ALL PERSONS BY THESE PRESENTS, that we, the undersigned _____ _____, as Principal, and _____ as Sureties, are hereby held and firmly bound unto _____ _____ as Obligee(s), in the penal sum of _____ dollars, for the payment of which well and truly to be made, we jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

SIGNED AND SEALED this _____ day of _____, _____.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that whereas the above-named Principal did on the _____ day of _____, _____, enter into a Contract with the Obligee, which said Contract is made a part of this Bond the same as though set forth herein and which is more fully described as:

Project Number: _____

Project Name: _____

Contract Description: _____
(e.g., General Trades, Plumbing, HVAC, Electrical)

NOW, THEREFORE, if the above-named Principal shall well and faithfully do and perform the things agreed by the Obligee to be done and performed according to the terms of said Contract; and shall pay all lawful claims of Subcontractors, Material Suppliers, and laborers, for labor performed and materials furnished in the carrying forward, performing, or completing of said Contract; we agreeing and assenting that this undertaking shall be for the benefit of any Subcontractor, Material Supplier or laborer having a just claim as well as for the Obligee herein; then this obligation shall be void; otherwise the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the Sureties for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

THE SAID Surety hereby stipulates and agrees that no modifications, omissions, or additions, in or to the terms of the said Contract or in or to the Plans and Specifications therefor shall in any wise affect the obligations of said Surety on its bond, and it does hereby waive notice of any such modifications, omissions or additions in or to the terms of the Contract, the Work or the Contract Documents, including without limitation the Plans and Specifications.

PRINCIPAL:

_____
Principal Signature

By: _____

Title: _____

SURETY:

_____
Surety Signature

By: _____
Attorney-in-Fact

SURETY INFORMATION:

_____
Street

_____
City State Zip

_____
Telephone Number

SURETY AGENT'S INFORMATION:

_____
Agency Name

_____
Street

_____
City State Zip

_____
Telephone Number

_____
Email Address

END OF DOCUMENT

Certified Payroll Report (Prevailing Wage)

☐ CHECK IF CORRECTED

State of Ohio Standard Forms for Public Facility Construction

EMPLOYER NAME AND ADDRESS	NAME OF GENERAL / PRIME CONTRACTOR	PROJECT NAME AND LOCATION (COUNTY)	CONTRACTING PUBLIC AUTHORITY / OWNER

CHECK IF SUBCONTRACTOR[1]	WEEK ENDING	PAYROLL NUMBER PAGE[2]	PROJECT / CONTRACT NUMBER
☐		_____ _____ of _____	

1. NAME, CURRENT ADDRESS,[3] AND LAST FOUR DIGITS OF SOCIAL SECURITY NUMBER	2. WORK[4] CLASSIFI-CATION	3. RACE AND SEX	4. HOURS WORKED - DAY AND DATE								5. TOTAL PROJ HRS	6. BASE WAGE RATE	7. PROJ GROSS WAGES	8. FRINGES: CASH ☐ APPROVED PLANS ☐ CASH AND APPROVED PLANS ☐					9. TTL HRS ALL JOBS	10. TOTAL GROSS ALL JOBS	11. TAXES WITH-HELD	12. OTHER DEDUC-TIONS	13. NET WAGES PAID
														H&W	PENS	VAC	APP	OTHER					
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My signature on this form signifies that (1) I pay, or supervise the payment of the employees shown above; (2) during the pay period reported on this form, all hours worked on this Project have been paid at the appropriate prevailing wage rate for the class of work done; (3) the fringe benefits have been paid as indicated above; (4) no rebates or deductions have been or will be made, directly or indirectly from the total wages earned, other than permissible deductions as defined in Ohio Revised Code Chapter 4115; and (5) apprentices are registered with the U.S. Department of Labor, Bureau of Apprenticeship and Training. I understand that the willful falsification of any of the above statements may subject the Contractor or Subcontractor to civil action or possible criminal prosecution.

Type or Print Name and Title: _____ Signature: _____ Date: _____

[1]If Subcontractor, provide Contractor name in space provided. [2]Attach additional pages as necessary. [3]Text will wrap. [4]Text will fit to cell.

CONTRACTOR'S PERSONAL PROPERTY TAX AFFIDAVIT
(O.R.C. § 5719.042)

State of Ohio
County of _____, ss:

_____, being first duly sworn, deposes and says that he/she is the
(Name)

_____ of _____
(Title) **(Name and Address of Contractor)**

_____ (the "Contractor") and

as its duly authorized representative, states that effective this _____ day of _____, 20___,

the Contractor:

( ) is charged with delinquent personal property taxes on the general list of personal property as set forth below:

County	Amount (include total amount penalties and interest thereon)
_____ County	$_____
_____ County	$_____
_____ County	$_____

( ) is not charged with delinquent personal property taxes on the general list of personal property in any Ohio county.

_____
(Affiant)

Sworn to and subscribed before me by the above-named affiant this _____ day of _____, 20___.

_____
(Notary Public)

My commission expires

_____, 20__

Document 00 71 00 - Contracting Definitions (General Contracting Project)
State of Ohio Standard Requirements for Public Facility Construction

Acceptable Component	A component listed in the Specifications after the Basis of Design Component.
Addenda or Addendum	Written or graphic instrument issued prior to the bid opening which modifies or interprets the proposed Contract Documents by additions, deletions, clarifications, or corrections. Addenda become part of the Contract Documents when the Agreement is executed.
ADR	See "Alternative Dispute Resolution."
A/E	See "Architect/Engineer."
Agreement	The form furnished by the Contracting Authority (including all of its exhibits) that, when completed and signed by the Contractor and Contracting Authority evidences entry into the Contract.
Allowance	A sum stipulated in the Contract Documents for a defined scope of the Work that may not be completely defined at the time of bidding. Allowance amounts do not include the Contractor's Fee on account of the associated Work.
Alternate	A change in the proposed Project scope, which may include but is not limited to alternate materials or methods of construction, and an amount stated on the Bid form to be added to or deducted from the Base Bid if the corresponding Alternate is incorporated into the Contract.
Alternative Dispute Resolution	A voluntary and non-binding process for the administrative review, consideration, and attempted settlement of a dispute, without resort to judicial process, including but not limited to partnering, negotiation, mediation, impartial fact-finding, dispute review board, and mini-trials, but shall not include arbitration.
Applicable Law	All federal, state, and local codes, statutes, ordinances, and regulations that apply to the performance of the Work or the A/E's Services on the Project.
Architect/Engineer	The Person responsible for providing professional design services and construction contract administration for the Project as provided in the Contract Documents. The A/E shall be a **(1)** registered architect holding a license and certificate of authorization issued by the Ohio Architects Board pursuant to ORC Chapter 4703, **(2)** landscape architect holding a license and certificate of authorization issued by the Ohio Landscape Architects Board pursuant to ORC Chapter 4703, or **(3)** professional engineer or professional surveyor holding a license and certificate of authorization issued by the Ohio Engineers and Surveyors Board pursuant to ORC Chapter 4733.
As-Built Documents	Documents, including but not limited to Drawings, Addenda, Specifications, Modifications, and other elements of the Contract Documents which the Contractor annotates and otherwise modifies to indicate changes made during the construction process, the location of concealed and buried items, and other information useful to the Owner throughout the life of the completed Project.
Base Bid	The amount stated in a Bid as the sum for which the Bidder offers to perform the Work in a particular trade or other category, which is described in the Contract Documents, excluding Alternates.
Basis of Design	A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
Basis of Design Component	A component listed first in the Specifications.

Bid	A written proposal to perform a Contract, submitted on a completed Bid Form, accompanied by other required documents. The term Bid includes a proposal that has been digitally signed, encrypted, and submitted through the State's electronic bidding application pursuant to OAC Section 153:1-8-01.
Bidder	A Person that submitted a Bid.
BIM	See "Building Information Model."
Bid Form	A form furnished by the Contracting Authority with the proposed Contract Documents that is to be completed, signed, and submitted containing the Bidder's Bid.
Bid Guaranty	A bid bond or other instrument of security authorized by ORC Section 153.54 submitted with the Bid to provide assurance that the Bidder will execute the Agreement.
Bond	A performance and payment bond in the format specified by ORC Section 153.57 submitted by the Contractor to provide assurance that the Contractor will perform the Work of the Contract, including making required payments to Subcontractors and Materials Suppliers.
Building Information Model	A digital representation of physical and functional characteristics of a facility; a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle, which is defined as existing from earliest conception to demolition; electronic files used to design and coordinate the Project; and may be used to describe a single model or multiple models used in the aggregate.
Certificate of Contract Completion	A form used to document that the Contractor's achievement of Contract Completion. This form may also be used to document partial Contract Completion.
Certificate of Substantial Completion	A form used to document **(1)** that the Contractor has achieved Substantial Completion of the Work or a designated portion of the Work for which the Contracting Authority and the Owner have agreed to take Partial Occupancy, and **(2)** the date on which the associated Substantial Completion of the Work was achieved.
Change Directive	A written document prepared by the A/E and executed by the Contracting Authority that directs a change in the Work.
Change Order	A document recommended by the A/E and executed by the Contracting Authority and the Contractor that modifies the Contract.
Claim	A demand or assertion, initiated by written notice, certified by one of the parties to the Contract seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time, or other relief with respect to the terms of the Contract.
Commission	See "Ohio Facilities Construction Commission."
Commissioning Agent	The Person identified by the Contracting Authority who leads, plans, schedules, and coordinates the commissioning team to implement the Commissioning Process for the Project.
Commissioning Plan	A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.
Commissioning Process	A quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all of its systems are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.

Commissioning Report A document that records the activities and results of the Commissioning Process. The Commissioning Report is developed from the final Commissioning Plan with its attached appendices.

Conformed Documents Contract Documents with all Addenda items and accepted Alternates incorporated by the A/E, published, and issued to a successful Bidder for its use during performance of the Contract. The Conformed Documents are furnished solely for the Contractor's convenience. In the event of any conflict between the Contract Documents modified by Addenda and the Conformed Documents, the Contract Documents take precedence.

Construction Budget The amount identified in the Agreement as adjusted by the Owner and Contracting Authority.

Construction Cost The sum of the Contract Cost amounts for a phase of the Project.

Construction Progress Schedule The critical path schedule for performance of the Contract; showing the time for completing the Work within the Contract Times; the planned sequence for performing the various components of the Work; the interrelationship between the activities of the Contractor, A/E, Contracting Authority, and Owner; and the Contractor's resource and cost loading information; as periodically updated during the performance of the Work.

Contract The state of legal obligation entered into by the State and the Contractor, whereby they have agreed to an exchange of certain acts, materials, equipment, and services for certain monetary consideration, under all terms and conditions specified in the Contract Documents, which shall remain in full force and effect until such time as all obligations under the Contract have been lawfully and completely discharged, or the Contract is terminated under other conditions specified in the Contract Documents.

Contract Completion The schedule Milestone in the progress of any Phase when the Work is completed in accordance with the terms of the Contract Documents and Contractor has satisfied all of its other obligations under the Contract Documents, including but not limited to **(1)** all governmental authorities have given final, written approval of the Work, **(2)** a final unconditional certificate of occupancy has been granted and issued to the Owner by the appropriate governmental authorities, **(3)** the Contractor's Work is 100 percent complete, and **(4)** all Punch List items have been completed or corrected, and **(5)** the Contractor has complied with conditions precedent to final payment and release of retained funds.

Contract Documents Collectively, the documents that constitute the substance of the Contract including Drawings, Specifications, Addenda if any, General Conditions, Supplementary Conditions if any, Bid Form, Wage Rates; and the executed Agreement, Bid Guaranty and Contract Bond, and Modifications if any.

Contract Sum The Contract Sum is the Contractor's entire compensation for the Contractor's proper, timely, and complete performance of the Work and is subject to adjustment as provided in the Contract.

Contract Times The periods stipulated in the Agreement for the achievement of associated Milestones, in consecutive days, beginning on the date established by the Notice to Proceed, including adjustments authorized by executed Change Orders.

Contracting Authority The party identified as such in the Agreement, which may be the Ohio Facilities Construction Commission; an agency of the state of Ohio; an Institution of Higher Education or division thereof; a School District Board; or the legislative body of a political subdivision.

Contractor A firm, which is party to the Contract for the performance of Work on the Project in accordance with the Contract Documents.

Contractor's Documents All Project-related documents, including those in electronic form, prepared by the Contractor and its Subcontractors.

Contractor's Fee	The portion of the Contract Sum attributable to the aggregate of the Contractor's profit and home-office overhead related to the Contractor's proper, timely, and complete performance of the Work.
Contractor Payment Request	The form furnished by the Commission that is to be used by the Contractor in requesting payments and which, when signed by the Contractor, shall serve as an affidavit that payments requested are in proportion to the Work completed as shown on the Schedule of Values.
Contractor's Punch List	A document prepared by the Contractor that consists of a list of items of Work to be completed or corrected by the Contactor as a condition precedent to Contract Completion.
Coordination Drawings	Drawings and Electronic Files prepared by the Contractor to demonstrate how multiple-system and interdisciplinary work will be coordinated. Clash reports generated by BIM authoring software may be included in the Coordination Drawing submittals if applicable.
Correction Period	A period of one year commencing on the date of Substantial Completion of the Work or a designated portion of the Work which the Contracting Authority and Owner have agreed to take Partial Occupancy.
CxA	See "Commissioning Agent."
Date of Commencement	The date established in a Notice to Proceed issued by the Contracting Authority to the Contractor to mark the start of the Work and the beginning of the running of the Contract Times.
day	A calendar day of 24 hours measured from midnight to midnight, unless otherwise expressly specified to mean a business day.
Defective Work	Work that does not conform to the Contract Documents; or does not meet the requirements of any applicable statute, rule or regulation, inspection, reference standard, test or approval; or has been damaged prior to the A/E's recommendation of final payment, unless responsibility for the protection thereof has been expressly assumed by the Owner; or that is not free from defects in workmanship, materials, or equipment during the period of any warranty or guarantee.
Differing Site Condition	Either **(1)** a subsurface or otherwise concealed physical condition encountered at the Site that differs materially from the conditions indicated in the Contract Documents or **(2)** an unknown physical condition of an unusual nature encountered at the Site that differs materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents.
Dispute Review Board	A form of Alternative Dispute Resolution that is typically comprised of three members, selected jointly by the Contractor and the Contracting Authority, to monitor the progress of construction and provide recommended resolutions to disputes that are brought before them.
Drawings	Graphic portions of the Contract Documents, showing the design, type of construction, location, dimension, and character of the Work to be provided by the Contractor, which generally includes plans, elevations, sections, details, schedules, diagrams, notes, and text.
Electronic File	Information maintained in a computer system or format that is intended to facilitate a Person's use and manipulation of the information including but not limited to Word, Excel, PDF, Primavera, CAD, and BIM files all in their native format.
Enclosure, Permanent	The condition in which the permanent exterior walls and roofs are in place, insulated and weathertight, and permanent windows and entrances are in place.
Enclosure, Temporary	The condition in which the permanent exterior walls and roofs are in place, insulated and weathertight, and windows and entrances are provided with suitable temporary enclosures.

Estimated Construction Cost The sum of the Estimated Contract Cost amounts published in the Solicitation, as modified by Addenda, for a phase of the Project.

Estimated Contract Cost The estimated amount for the Contract published in the Solicitation, including the Base Bid estimate and the estimates of selected Alternates, if any, as modified by Addenda.

Extra Materials Materials required by the Contract Documents that are not incorporated into the Project but are given to the Owner to be used for future maintenance or repairs.

Fee See "Contractor's Fee."

Final Inspection The final review of the Work of the Contractor by the A/E to determine whether issuance of the Certificate of Contract Completion is appropriate.

furnish Supply and deliver to the Site, or other specified location, ready for installation.

General Conditions The State's Standard General Conditions in effect as of the date of the Agreement.

General Conditions Costs General Conditions Costs include only the Contractor's costs to provide the general conditions Work including without limitation the costs of all of the following Site-related items: scheduling and coordinating the Work. telephone, telephone charges, facsimile, telegrams, postage, photos, photocopying, hand tools, simple scaffolds (one level high), tool breakage, tool repairs, tool replacement, tool blades, tool bits, and pre-approved travel, lodging, and parking costs. General Conditions Costs also include **(1)** Bond premiums and **(2)** premiums for builder's risk insurance if the Contractor purchases the builder's risk policy for the Project.

Hazardous Materials Any material, substance, pollutant, or contaminant that is defined, regulated, referenced, or classified in the Comprehensive Environmental Response, Compensation and Liability Act, Federal Water Pollution Control Act, the Resource Conservation and Recovery Act, Clean Air Act, Hazardous Materials Transportation Uniform Safety Act, Toxic Substances Control Act, or any other Applicable Law relating to any hazardous, toxic, or dangerous waste, substance, or material. Any substance or material that, after release into the environment or upon exposure, ingestion, inhalation, or assimilation, either directly from the environment or directly by ingestion through food chains, will, or may reasonably be anticipated to, cause death, disease, behavior abnormalities, cancer or genetic abnormalities and specifically includes but is not limited to asbestos, polychlorinated biphenyls ("PCBs"), radioactive materials, including radon and naturally occurring radio nuclides, natural gas, natural gas liquids, liquefied natural gas, synthetic gas, oil, petroleum and petroleum-based derivatives and urea formaldehyde.

Indemnified Parties The State, Contracting Authority, Owner, A/E, other Separate Consultants, and their respective officials, officers, consultants, agents, representatives, and employees, in both individual and official capacities.

install Put into use or place in final position, complete and ready for intended service or use.

Institutional Designee The party identified in the Agreement empowered with a level of authority similar to the Executive Director of the Commission, which may be the university architect or engineer, director of capital facilities, or an institution vice president.

Institution of Higher Education Any state of Ohio university or college, community college, state of Ohio community college, technical college, university branch, community college district, technical college district, university branch district, and the applicable board of trustees or, in the case of a university branch district, any other managing authority.

Liquidated Damages A sum established in the Contract Documents, pursuant to the statutory delay forfeiture authorized under ORC Section 153.19, to be paid to the Owner due to the Contractor's failure to complete the Work within the Contract Time for achievement of Substantial Completion, or any applicable portion of the Work on or prior to any Milestone date stated on the Agreement.

Material Supplier	A Person under a contract with the Contractor to furnish materials or supplies in furtherance of the Work, including all such Persons in any tier. Material Supplier does not include any Separate Contractor unless expressly assigned in writing to the Contractor by the Owner and accepted by the Contractor.
mediation	A voluntary process in which a neutral third party meets with the parties who have a disagreement or dispute and attempts to facilitate a mutually satisfactory resolution.
Milestone	A principal event specified in the Contract relating to a completion date or time.
Modification	A **(1)** written amendment to the Contract signed by both parties, **(2)** Change Order, **(3)** Change Directive, or **(4)** an order for a minor change in the Work.
negotiation	A form of Alternative Dispute Resolution in which all parties involved are represented by those invested with the authority to agree to a determination of an adjustment in the Contract Sum, Contract Times, or both.
Neutral Facilitator	A nonpartisan third-party without decision-making authority who is engaged to assist the Project's key stakeholders in developing cooperative relationships, achieving project objectives, avoiding or minimizing disputes, and nurturing a more-collaborative ethic characterized by trust, cooperation, and teamwork.
Notice of Commencement	A notice prepared by the Contracting Authority identifying the Project, the Contractors, the Surety for each Contractor, and the name of the Contracting Authority's representative upon whom a claim affidavit may be served.
Notice of Intent to Award	A written notice provided by the Contracting Authority to the apparent successful Bidder stating that upon satisfactory compliance with all conditions precedent for execution of a Contract within the time specified, the Contracting Authority intends to execute a Contract with the Bidder.
Notice to Proceed	A written notice provided by the Contracting Authority authorizing the Contractor to proceed with the Work and establishing the dates for commencement and completion of the Work.
OAC	Ohio Administrative Code
Ohio Facilities Construction Commission	The authorized contracting agent for public improvement projects in accordance with ORC Chapters 123 and 153, acting by and through its Executive Director.
ORC	Ohio Revised Code
Owner	The state of Ohio agency, Institution of Higher Education or division thereof, School District Board, or other instrumentality for whom the Project is being constructed.
Owner's Project Requirements	A written document that details the functional requirements of the Project and the expectations of how it will be used and operated. These requirements include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
Partial Occupancy	The condition that occurs when the Owner occupies or uses a portion of the Project prior to Contract Completion, partial occupancy is approved by authorities with jurisdiction over the Project and the insurer(s) providing the builders risk insurance, and items of Work cannot be completed until a subsequent date.
partnering	A voluntary dispute prevention process involving team building activities to help define common goals, improve communication, and foster a problem-solving attitude among a group of contracting parties that must work together throughout Contract performance to be less adversarial and more cooperative.
Payment Request	See "Contractor Payment Request."
Person	An individual, corporation, business trust, estate, partnership, association, or other public or private entity.

Phase	A separation in the Work of the Project by sequence or time intervals, which may include separate contractors for each Phase.
Plan Holder	A prospective Bidder that received a set of Contract Documents prior to the bid opening.
Product Data	Manufacturer's standard illustrations, schedules, diagrams, performance charts, instructions, and brochures that illustrate physical appearance, size, and other characteristics of materials and equipment.
Project	The public improvement, of which the Work performed under the Contract Documents may be the whole or a part.
Project Manager	A permanent employee of the Contracting Authority assigned to the Project and authorized to perform specific responsibilities.
Project Manual	That part of Construction Documents which consists of bound volume(s) of primarily written material which generally contain Division 00 - "Procurement and Contracting Requirements," and Divisions 01 through 49 - "Specifications," and other documents pertaining to the Project.
Proposal	The offer of a Contractor to perform the Work set forth in a Proposal Request.
Proposal Request	A document issued after execution of the Contract requesting a Proposal from the Contractor(s), which may initiate a Change Order to modify the Contract.
provide	Furnish and install, complete and ready for intended use.
Punch List	A document listing items of Work requiring correction or completion by the Contractor as a condition precedent to Contract Completion.
Punch List Milestone	The date 30 days after the achievement of Substantial Completion of all or a portion of the Work.
Record Documents	Electronic files and printed documents of all nature prepared by the A/E, which incorporate the information shown on the Contractor's As-Built Documents. They consist of the "Record Drawings" and "Record Project Manual," Certificate of Substantial Completion, Certificate of Contract Completion (as complete), Contractor's Warranty, Manufacturers' Warrantees, certificate(s) of occupancy, approved shop drawings and other action submittals, responses to Requests for Information, Addenda, Modifications, Balancing Reports, and the final version of the approved Construction Progress Schedule.
Record Drawings	The Drawings, which have been revised by the A/E to show the changes made during the construction process, conformed to represent the Work as executed by the Contractor.
Record Model	The Building Information Model, which has been revised by the A/E to show the changes made during the construction process, conformed to represent the Work as executed by the Contractor.
Record Project Manual	The Project Manual of the Contract Documents, which has been revised by the A/E to show the changes made during the construction process, based on the As-Built Project Manual furnished by the Contractor.
Request for Change Order	A written notice from the Contractor accompanied by a Proposal for a change in the Work.
Request for Information	A written request to the A/E seeking an interpretation or clarification of the Contract Documents.
RFI	See "Request for Information."
Samples	Physical examples, color selection items, field samples, and mock-ups furnished by the Contractor to illustrate functional and aesthetic characteristics of products, materials, equipment, or workmanship and establish criteria by which the Work shall be judged.

Schedule of Values A full, accurate, and detailed statement furnished by the Contractor reflecting a defined breakdown of the Contract Sum.

School District A local, exempted village, or city school district as defined in ORC Chapter 3311, or a joint vocational school established pursuant to ORC Section 3311.18, performing essential governmental functions of state government pursuant to ORC Sections 3318.01 to 3318.20.

School District Board The board of education of a School District.

Separate Consultant A Person engaged by the Owner or Contracting Authority to provide Project-related professional services other than the services under this Contract. The term includes the Separate Consultant's authorized representatives, successors, assigns, and subconsultants regardless of tier.

Separate Contract The contract between the Owner or Contracting Authority and a Separate Consultant or a Separate Contractor.

Separate Contractor A Person under contract with the Owner or Contracting Authority to provide Project-related work other than the Work under this Contract. The term includes the Separate Contractor's authorized representatives, successors, assigns, and subcontractors regardless of tier.

Shop Drawings Drawings, diagrams, illustrations, and schedules specifically prepared for the Project provided by the Contractor or a Subcontractor to illustrate some portion of the Work. Shop Drawings are not Contract Documents. Shop Drawings on equipment shall include a written statement from the manufacturer of the equipment certifying the equipment is in compliance with the Contract Documents.

Site The location designated for the Project.

Specifications Those portions of the Contract Documents consisting of detailed written administrative, procedural, and technical requirements, included in Divisions 01 through 49, for the construction of the Work, whether physically on the Drawings or bound in separate volumes, including identification of acceptable materials, methods, equipment, quality, and workmanship.

Stage A distinct period in the life cycle of a facility from concept through construction, to use and deconstruction or demolition. Typical Stages include Program Verification, Schematic Design, Design Development, Construction Documents, Bidding and Award stages; and the Construction Stage, which includes Construction and Closeout activities.

Standard Requirements The brief name of the "State of Ohio Standard Requirements for Public Facility Construction," including but not limited to General Conditions, and other Division 00 Documents and Division 01 Sections; in effect as of date of the Agreement.

State The government of Ohio, including any organized body, office, or agency established by the laws of this state for the exercise of any function of state government, or any state institution of higher education as defined in ORC Section 3345.011.

Subcontract Any contract or agreement between the Contractor and a Subcontractor for performance of a portion of the Work.

Subcontract Form The **State of Ohio Subcontract Form** prescribed by OAC Section 153:1-3-02 and required for use with the General Contracting method of project delivery.

Subcontractor A Person who undertakes to perform any part of the Work on the Project under a contract with a Contractor or with any Person other than the State, including all such Persons in any tier. The term "Subcontractor" includes Material Suppliers, but does not include any Separate Contractor unless expressly assigned in writing to the Contractor by the Owner and accepted by the Contractor.

Substantial Completion The stage in the progress of the Work when the Work (or designated portion of the Work for which the Contracting Authority and Owner have agreed to take Partial Occupancy) is sufficiently complete in accordance with the Contract that the Owner can utilize the Work for its intended use, as determined by the A/E. The issuance of a certificate of occupancy or partial certificate of occupancy (if applicable) is a condition precedent to the achievement of Substantial Completion.

Substantially Complete See "Substantial Completion."

Substitution An article, device, material, equipment, form of construction, or other item, proposed by a prospective Bidder prior to the bid opening and approved by the A/E by Addendum, for incorporation or use in the Work as being functionally and qualitatively equivalent to essential attributes of a Basis of Design or Acceptable Component specified in the proposed Contract Documents.

Supplementary Conditions Amendments to the General Conditions, issued as a separate document, which describe conditions of the Contract unique to a particular Owner or Project, which may include provisions regarding the assignment of responsibility for refuse removal, safety and security precautions and programs, temporary Project facilities and utilities, weather and fire protection, scaffolding and equipment, materials and services to be used commonly by the Contractor and Subcontractors and requiring the Contractor to provide assistance in the utilization of any applicable equipment system, preparation of operation and maintenance manuals, and training of Owner personnel for operation and maintenance of the Project. The General Conditions shall not be superseded or amended by Drawings and Specifications, unless so provided in Supplementary Conditions prepared by the Contracting Authority and approved by the Commission.

Supplementary Instructions Amendments to the Instructions to Bidders, issued as a separate document, which describe instructions unique to a particular Owner or Project. The Instructions to Bidders shall not be superseded or amended by Drawings and Specifications, unless so provided in Supplementary Instructions prepared by the Contracting Authority and approved by the Commission.

Surety A Person providing a Bid Guaranty or a Bond to a Bidder or a Contractor, as applicable, to indemnify the State against all direct and consequential damages suffered by failure of the Bidder to execute the Contract, or of the Contractor to perform the Contract and to pay all lawful claims of Subcontractors, Material Suppliers and laborers, as applicable.

Systems Manual A system focused composite document that includes the operation manual, maintenance manual, and additional information of use to the Owner after they begin using the facility.

Unit Price The cost of providing a unit of Work including labor, materials, services, and associated expenses. Unit Prices do not include the Contractor's Fee on account of the associated Unit Price Work.

Work The labor, materials, equipment, and services, individually or collectively which are required by the Contract Documents, to be performed or provided by the Contractor for the Project. The furnishing of all material, labor, detailing, layout, supplies, plants, tools, scaffolding, transportation, temporary construction, superintendence, demolition, and all other services, facilities and items reasonably necessary for the full and proper performance and completion of the requirements of the Project as set forth in the Contract Documents, and items reasonably inferable therefrom and consistent therewith for the proper execution and completion of the construction and other services required by the Contract Documents, whether provided or to be provided by the Contractor or a Subcontractor, or any other entity for whom the Contractor is responsible, and whether or not performed or located on or off of the Site.

END OF DOCUMENT

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ARTICLE 1 - CONTRACTOR'S RESPONSIBILITIES

1.1 Nondiscrimination

1.1.1 The Contractor shall comply with Applicable Law regarding equal employment opportunity, including ORC Section 153.59 and all Executive Orders issued by the Governor of the state of Ohio.

1.1.1.1 As required under ORC Section 153.59, the Contractor agrees to both of the following:

.1 "in the hiring of employees for the performance of work under the contract or any subcontract, no contractor, subcontractor, or any person acting on a contractor's or subcontractor's behalf, by reason of race, creed, sex, disability or military status as defined in section 4112.01 of the Revised Code, or color, shall discriminate against any citizen of the state in the employment of labor or workers who is qualified and available to perform the work to which the employment relates;" and

.2 "no contractor, subcontractor, or any person on a contractor's or subcontractor's behalf, in any manner, shall discriminate against or intimidate any employee hired for the performance of work under the contract on account of race, creed, sex, disability or military status as defined in section 4112.01 of the Revised Code, or color."

1.1.1.2 The Contractor shall cooperate fully with the State's Equal Opportunity Coordinator ("EOC"), with any other official or agency of the state or federal government that seeks to eliminate unlawful employment discrimination, and with all other state and federal efforts to assure equal employment practices under the Contract.

1.1.1.3 In the event the Contractor fails to comply with these nondiscrimination clauses, the Contracting Authority shall deduct from the amount payable to the Contractor a forfeiture of the statutory penalty pursuant to ORC 153.60 for each person who is discriminated against or intimidated in violation of this **Section 1.1.1**.

1.1.1.4 The Contract may be terminated or suspended in whole or in part by the Contracting Authority and all money to become due hereunder may be forfeited in the event of a subsequent violation of this **Section 1.1.1**.

1.1.2 Hiring Under State Public Improvement Contracts.

1.1.2.1 Any provision of a hiring hall contract or agreement which obligates the Contractor to hire, if available, only employees referred to the Contractor by a labor organization shall be void as against public policy and unenforceable with respect to employment under any public improvement contract unless at the date of execution of the hiring hall contract or agreement, or within 30 days thereafter, the labor organization has procedures in effect for referring qualified employees for hire without regard to race, color, religion, national origin, military status as defined in ORC Section 4112.01, or ancestry and unless the labor organization includes in its apprentice and

journeyman's membership, or otherwise has available for job referral without discrimination, qualified employees, both whites and non-whites (including African-Americans).

1.2 Prevailing Wages

1.2.1 The Contractor shall comply with the prevailing wage requirements described under ORC Chapter 4115 that include, without limitation, the requirements described under this **Section 1.2**.

1.2.2 If the Project is subject to payment of prevailing wage rates, the Contractor shall:

1.2.2.1 pay to laborers and mechanics performing Work on the Project the prevailing wage rates of the Project locality, as determined by the Ohio Department of Commerce, Wage and Hour Bureau;

1.2.2.2 post in a prominent place readily accessible by all workers on the Site, a legible listing of the current classifications of laborers, workers, and mechanics employed under this Contract;

1.2.2.3 ensure that the rates posted are current and remain posted in legible condition during the period of the Contract; and

1.2.2.4 not be entitled to an increase in the Contract Sum on account of an increase in prevailing wage rates, except as otherwise provided by Applicable Law.

1.2.3 The Contractor may access the Ohio Department of Commerce, Wage & Hour Bureau at its website, http://198.234.41.198/w3/webwh.nsf/pages/PrevailingWageBid, to obtain the current wage rates.

1.3 Royalties and Patents

1.3.1 The Contractor shall pay all royalties and license fees and assume all costs incident to the use, in the performance of the Work or the incorporation in the Work, of any invention, design, process, product, or device that is the subject of patent rights or copyrights held by others.

1.3.2 If the Contractor has reason to believe that use of the specified item is subject to patent or copyright protection, the Contractor shall immediately notify the Contracting Authority.

1.4 Assignment of Antitrust Claims

1.4.1 By signing the Agreement, the Contractor assigns, conveys and transfers to the Contracting Authority any right, title, and interest to any claims or causes of action it may have or acquire under state or federal antitrust laws relating to any goods, products, or services purchased, procured, or rendered to the State pursuant to the Contract.

1.5 Use of Domestic Steel

1.5.1 The Contractor is required by law to supply domestically produced steel products used for load bearing structural purposes on all projects funded in whole or in part with State funds.

1.5.2 The Contractor and Subcontractors shall comply with ORC Section 153.011 regarding the use of domestically produced steel products for load bearing structural purposes on all projects funded in whole or in part with State funds. Copies of ORC Section 153.011 may be obtained from the Ohio Facilities Construction Commission or downloaded at http://codes.ohio.gov/orc/153.011v1.

1.6 Drug Free Safety Program Participation

1.6.1 Throughout the performance of the Work, the Contractor shall be enrolled in and remain in good standing in the Ohio Bureau of Workers' Compensation ("OBWC") Drug-Free Safety Program ("DFSP") or a comparable program approved by the OBWC that meets the requirements specified in ORC Section 153.03 ("OBWC-approved DFSP").

1.6.2 As required under ORC Section 153.03(E):

1.6.2.1 "Each contractor shall require all subcontractors with whom the contractor is in contract for the public improvement to be enrolled in and be in good standing in the Bureau of Workers' Compensation's Drug-Free Workplace Program or a comparable program approved by the Bureau that meets the requirements specified in section 153.03 of the Revised Code prior to a subcontractor providing labor at the project site of the public improvement."

1.6.2.2 "Each subcontractor shall require all lower-tier subcontractors with whom the subcontractor is in contract for the public improvement to be enrolled in and be in good standing in the Bureau of Workers' Compensation's Drug-Free Workplace Program or a comparable program approved by the Bureau that meets the requirements specified in

section 153.03 of the Revised Code prior to a lower-tier subcontractor providing labor at the project site of the public improvement."

1.6.2.3 "Failure of a contractor to require a subcontractor to be enrolled in and be in good standing in the Bureau of Workers' Compensation's Drug-Free Workplace Program or a comparable program approved by the Bureau that meets the requirements specified in section 153.03 of the Revised Code prior to the time that the subcontractor provides labor at the project site will result in the contractor being found in breach of the contract and that breach shall be used in the responsibility analysis of that contractor or the subcontractor who was not enrolled in a program for future contracts with the State for five years after the date of the breach."

1.6.2.4 "Failure of a subcontractor to require a lower-tier subcontractor to be enrolled in and be in good standing in the Bureau of Workers' Compensation's Drug-Free Workplace Program or a comparable program approved by the Bureau that meets the requirements specified in section 153.03 of the Revised Code prior to the time that the lower-tier subcontractor provides labor at the project site will result in the subcontractor being found in breach of the contract and that breach shall be used in the responsibility analysis of that subcontractor or the lower-tier subcontractor who was not enrolled in a program for future contracts with the State for five years after the date of the breach."

1.6.3 Prior to authorizing a Subcontractor to commence Work on the Site, the Contractor shall obtain the Contracting Authority's approval, and shall also submit to the A/E written confirmation of the Subcontractor's enrollment on the **Subcontractor and Material Supplier Declaration** form.

1.6.4 In addition to OBWC-approved DFSP Basic requirements, the Contractor, each Subcontractor, and each Separate Contractor that provides labor on the Site shall participate in a pool that performs random drug testing of at least five percent of its employees who perform labor on the Site. The random drug testing percentage shall also include the on-site supervisors of the Contractor, Subcontractors, and Separate Contractors. Basic random drug testing shall otherwise comply with the same testing guidelines and criteria as required for OBWC-approved advanced testing. The Contractor and Subcontractor shall provide evidence of required testing to the Contracting Authority upon request.

1.7 Use of Project Management Software

1.7.1 If the Contracting Authority decides, in its sole discretion, to use project management software for the Project, the Contractor shall use that software for all compatible services required under this Contract.

1.7.2 All costs for the Contractor's use of the project management software for the Project shall be included in the Contract Sum. If the Contractor is unfamiliar with the proper use of the software, the Contractor shall provide its employees for training without additional compensation.

1.8 EDGE Participation and Reporting

1.8.1 The Contractor shall participate in the "Encouraging Diversity, Growth and Equity" ("EDGE") Program by subcontracting with, and using one or more, businesses certified as an EDGE Business Enterprise ("EDGE-certified Business") by the Ohio Department of Development.

1.8.1.1 If the Contractor is an EDGE-certified Business, the Contractor may include its own compensation under this Contract in the reporting.

1.8.1.2 The amount of EDGE participation cannot exceed 100 percent of the Contract Sum.

1.8.1.3 The Contractor shall include in the reporting only those expenditures to EDGE-certified Businesses that perform a commercially useful function as described in the OAC.

1.8.2 The Contractor shall provide an EDGE Participation Report with each Contractor Payment Request.

1.8.2.1 The Contractor shall provide status reports, produced by the Contractor and each applicable EDGE-certified Business for the Contract, indicating:

- **.1** the name of each EDGE-certified Business;
- **.2** the federal tax identification number of each EDGE-certified Business;
- **.3** the date of the EDGE-certified Business contract, Subcontract, or purchase order;
- **.4** the projected and actual start and end dates of the EDGE-certified Business contract, Subcontract, or purchase order;
- **.5** the original amount of the EDGE-certified Business contract, Subcontract, or purchase order with the Contractor;
- **.6** the current amount of the EDGE-certified Business contract, Subcontract, or purchase order;

.7 the amount invoiced to date;

.8 the amount paid to date;

.9 the status of the EDGE-certified Business contract, Subcontract, or purchase order (active, complete, or void); and

.10 a statement describing any substantive product or performance deficiencies.

1.8.2.2 The Contractor shall provide reports for each EDGE-certified Business; however, the reports may be consolidated and submitted as one document.

1.8.3 The Contractor shall provide an EDGE Participation Final Report simultaneously with its final Contractor Payment Request.

1.8.3.1 The Contractor and each EDGE-certified Business shall provide in the report certification that the submitted document is a true and accurate accounting of the original contract amount paid to and, received by each EDGE-certified Business.

1.8.4 The Contractor shall provide the EDGE Participation Reports in detail and form acceptable to the Contracting Authority.

1.8.4.1 Failure to timely submit EDGE Participation Reports may result in withholding payment in accordance with **Section 9.8**.

1.8.5 The Contractor shall cooperate fully with requests for additional EDGE information and documentation from the Ohio Department of Development or Contracting Authority.

1.9 Owner Work Rules

1.9.1 The Contractor shall consult with the Owner to obtain full knowledge of the Owner's rules, regulations, or requirements affecting the Project.

1.10 Emergency

1.10.1 In the event of an emergency affecting the safety of the Project, other property, or individuals, the Contractor, without special instruction or authorization, shall act to prevent the threatened damage, injury, or loss.

1.10.2 If the Contractor believes that it is entitled to an adjustment of the Contract Sum or Contract Times, or both, on account of its actions in response to an emergency, the Contractor shall initiate a Change Request **(1)** as required under **Section 7.6**; and **(2)** within the time period required under **Section 7.6**, which begins to run on the day that the emergency began.

1.11 Contractor's Standard of Care

1.11.1 The Contractor shall perform the Work in a workmanlike manner, consistent with the standards of skill and care exercised by entities licensed to perform (where required under Applicable Law) and regularly performing comparable work in the same or similar locality under the same or similar circumstances.

1.12 Limit of Contractor's Responsibility

1.12.1 The Contractor is not responsible for the A/E's negligence or the A/E's failure to properly perform the A/E's contract.

1.13 Sustainability Requirements

1.13.1 This Project shall be designed and constructed in accordance with the requirements, rules, policies, and procedures adopted by the Ohio Facilities Construction Commission establishing Sustainability Requirements for Capital Improvements Projects, including but not limited to the applicable provisions of OAC 3318-3.

1.13.2 If the Project is designed and constructed under the Leadership in Energy and Environmental Design ("LEED") Rating System developed by the U.S. Green Building Council or another rigorous rating system used to facilitate achievement of sustainability goals for the Project, the Contractor shall provide submittals certifying achievement of sustainable design rating system criteria for verification by the Green Building Certification Institute or other third party in accordance with the Contract Documents.

ARTICLE 2 - STATE'S RIGHTS AND RESPONSIBILITIES

2.1 Contracting Authority

2.1.1 The Contracting Authority shall designate a Project Manager for the Project. The Project Manager is authorized to act on behalf of the Contracting Authority to perform specific responsibilities under the Contract.

2.1.2 The Contracting Authority shall furnish information and services required of it in a timely manner.

2.1.3 The Contracting Authority shall have access to the Work at all times, whenever the Project is in preparation or progress.

2.1.4 The Ohio Facilities Construction Commission requires use of its forms where indicated in the Contract Documents. The party responsible for initiating forms shall utilize the latest edition obtained from the Commission's website: https://ofcc.ohio.gov. The Commission may make modifications to its forms at any time.

2.1.4.1 The Contractor shall not modify any form provided by the Commission or Contracting Authority.

2.1.4.2 If the Project is administered using project management software, the Contractor shall utilize the web-based forms and reports within the applicable business process. The project management software is sponsored by the Commission, and the web-based forms and reports are acceptable to the Commission in lieu of its paper forms.

2.1.5 The Contracting Authority is not responsible for construction means, methods, manners, techniques, sequences, procedures, or for safety precautions and programs in connection with the Work, or for the Contractor's failure to carry out the Work in conformity with the Contract Documents.

2.2 Owner

2.2.1 The Owner shall designate a representative authorized to act on behalf of the Owner during the Project.

2.2.2 The Owner shall furnish information and services required of it in a timely manner.

2.2.3 The Owner shall have access to the Work at all times whenever the Project is in preparation or progress.

2.2.4 Upon issuance of the Notice to Proceed, the Owner shall provide the Site to the Contractor in a condition to permit the Contractor to perform the Work.

2.2.5 The Owner may request a change in the Work if the A/E recommends and the Contracting Authority approves the change.

2.2.6 The Owner shall communicate with the Contractor through the Contracting Authority.

2.2.7 The Owner is not responsible for construction means, methods, manners, techniques, sequences, procedures, or for safety precautions and programs in connection with the Work, or for the Contractor's failure to carry out the Work in conformity with the Contract Documents.

2.3 Approval of Owner, Contracting Authority, and State

2.3.1 The Owner, Contracting Authority, or State's review and approval of the Work and any information the Contractor submits to them is for the sole purpose of determining whether the Work and information are generally consistent with the Contract's intent, and will not relieve the Contractor of its sole responsibility for the performance, preparation, completeness, and accuracy of the Work and information.

2.4 Neutral Facilitation

2.4.1 The Contracting Authority or Owner may engage a Neutral Facilitator for the purposes of **(1)** building cooperative relationships among the Project participants to achieve discrete objectives; **(2)** encouraging educated, productive, and expedited attempts to avoid, minimize, and resolve disputes; and **(3)** maximizing the effectiveness of each participant's resources.

2.4.1.1 For example, a Neutral Facilitator may facilitate the organizational meeting, partnering session(s), and efforts to resolve disputes throughout the Project.

2.4.2 The Contracting Authority, Owner, and Contractor are entitled to interact with the Neutral Facilitator with the full expectation that **(1)** they may act, speak, and disclose information with complete candor and **(2)** all communication, whether oral or written, made in the course of facilitated sessions is confidential.

2.4.3 At any hearing or proceeding regarding any dispute arising out of or related to the Project **(1)** the Neutral Facilitator will not be competent to testify and shall not be called as a witness and **(2)** the Neutral Facilitator's testimony and work product will not be admissible.

2.4.4 The Neutral Facilitator will not **(1)** perform any services with respect to or bear any responsibility for any legal services, design-professional services, construction, or construction management associated with the Project or **(2)** have any liability whatsoever for any claims related to any legal services, design-professional services, construction, or construction management associated with the Project, including without limitation, claims for legal or design-professional errors or omissions, delays, cost overruns, faulty construction, or increased costs.

2.4.5 The Neutral Facilitator's participation in the Project will not relieve the Contracting Authority, Owner, and Contractor of any of their respective rights or obligations under the Contract.

2.5 Contractor Performance Evaluation

2.5.1 The Contracting Authority may evaluate the Contractor's performance during the progress of the Work, at completion of a Phase of the Project, completion of the Project, or any of the foregoing. The Contracting Authority shall retain the evaluation(s).

2.5.1.1 The Contractor may request a copy of the completed evaluation(s). If the Contractor wishes to comment or take exception to any rating or remark, the Contractor shall send a response in writing to the Contracting Authority within 30 days after receiving the evaluation(s).

2.5.1.2 The Contracting Authority may use the evaluation(s) in determining the responsibility of the Contractor for award of future contracts.

2.5.1.3 The Contracting Authority may request information from the Contractor for use in evaluating the A/E's performance. If information is requested, the Contractor shall comply in a timely and responsive manner.

2.5.1.4 If a breach of the Contract is committed by the Contractor or is attributable to a Subcontractor, that breach will be used in the responsibility analysis of the Contractor and Subcontractor (where applicable) for future contracts with the State or subcontracts on State projects for five years after the date of the breach.

ARTICLE 3 - A/E'S RESPONSIBILITIES

3.1 The A/E's Contract Administration Duties

3.1.1 The A/E shall administer the Contract as provided in the Contract Documents and Architect/Engineer Agreement, including, but not limited to, performance of the functions described as follows:

3.1.1.1 The A/E shall attend and conduct progress meetings. The A/E shall prepare an agenda and produce a written report of each progress meeting, and distribute the report to the Contracting Authority, Owner, and Contractor within three business days after the meeting. The A/E shall not delegate the duty to prepare the agenda and written reports of any progress meeting.

3.1.1.2 The A/E may authorize minor changes or alterations in the Work that are consistent with the intent of the Contract Documents and do not involve adjustment of the Contract Sum or Contract Times, or both. The A/E has no authority to authorize the Contractor to perform additional or extra Work for which the Contractor may seek adjustment of the Contract Sum or Contract Times, or both.

3.1.1.3 The A/E shall review and recommend, certify, or approve applicable forms required under the Contract Documents.

3.1.1.4 The A/E shall render decisions in connection with the Contractor's responsibilities under the Contract Documents, and submit recommendations to the Contracting Authority for enforcement of the Contract as necessary.

3.1.2 The A/E is the initial interpreter of all requirements of the Contract Documents. All decisions of the A/E are subject to final determination by the Contracting Authority.

3.2 Site Visits and Observation

3.2.1 The A/E shall notify, advise, and consult with the Contracting Authority and Owner and protect the State against Defective Work throughout completion of the Project, which includes the Correction Period.

3.2.1.1 The A/E shall designate a field representative, subject to the Contracting Authority's approval, to attend to the Project, to observe and check the progress and quality of the Work, and to take action as necessary or appropriate to achieve conformity with the Contract Documents.

3.2.1.2 The A/E shall have its consultants attend to the Project at intervals required by its agreement or the Contracting Authority.

3.2.2 The A/E is authorized to disapprove or reject Defective Work. The A/E shall immediately notify the Contracting Authority any time the A/E disapproves or rejects an item of Work.

3.2.3 The A/E is not responsible for construction means, methods, manners, techniques, sequences, procedures, or for safety precautions and programs in connection with the Work, or for the Contractor's failure to carry out the Work in conformity with the Contract Documents.

3.3 Testing and Inspection Services

3.3.1 Unless otherwise specified in the Contract Documents, the A/E, directly or through a consultant, shall manage, apply for, secure, and pay for the costs of structural testing and special inspections under Chapter 17 of the Ohio Building Code; testing including geotechnical analysis, environmental testing and analysis, concrete, masonry, structural steel, reinforcing steel, welding, bolts, steel connections, HVAC systems and controls, plumbing and piping, air and water balancing and testing, or other testing; or approval required by Applicable Law. The Contractor shall coordinate with the A/E and cooperate in the A/E's effort to complete the testing and inspection services required in this **Section 3.3**

3.4 Approval of A/E

3.4.1 The A/E's review and approval of the Work and any information the Contractor submits to the A/E is for the sole purpose of determining whether the Work and information are generally consistent with the Contract's intent, and will not relieve the Contractor of its sole responsibility for the performance, preparation, completeness, and accuracy of the Work and information.

3.5 Limitation of A/E's Authority

3.5.1 Under no circumstances is the A/E authorized to:

3.5.1.1 bind the Owner or Contracting Authority to any authorizations under, modifications of, or amendments to any contract other than as expressly described under **Section 3.1.1.2**;

3.5.1.2 accept any defective or non-conforming services, Work, or vendor-furnished items;

3.5.1.3 make any settlements on behalf of the Owner or Contracting Authority; or

3.5.1.4 assume any responsibilities of the Contractor or Subcontractors.

ARTICLE 4 - SUBCONTRACTORS

4.1 Evaluation and Approval

4.1.1 Within ten days after the Notice to Proceed, or other period as mutually agreed by the Contractor and Contracting Authority, the Contractor shall submit to the A/E a **Subcontractor and Material Supplier Declaration** form through which the Contractor identifies its Subcontractors.

4.1.2 The Contractor's failure to timely submit the information regarding a proposed Subcontractor may result in withholding payment in accordance with **Section 9.8**.

4.1.3 After receiving the **Subcontractor and Material Supplier Declaration** form, the A/E shall verify that it is complete and deliver it to the Contracting Authority and Owner. If the A/E finds the form incomplete, the A/E shall return it to the Contractor and identify the incomplete information. If the A/E returns such incomplete forms to the Contractor, the Contractor shall resubmit the forms with revisions complying with the corrective action identified by the A/E.

4.1.4 If the Contracting Authority rejects any proposed Subcontractor, the Contractor shall propose a replacement Subcontractor with no adjustment of the Contract Sum. The proposed replacement Subcontractor will be evaluated as described above.

4.1.5 No less than ten days before Work is to be performed by the Subcontractor, or within a shorter period as mutually agreed by the Contractor and Contracting Authority, the Contractor shall submit to the Contracting Authority and A/E a complete copy of the executed Subcontract between the Contractor and Subcontractor. After receiving the Subcontract,

the A/E shall verify that it is complete and deliver it to the Contracting Authority. If the A/E finds the Subcontract incomplete, the A/E shall return it to the Contractor and identify the incomplete information.

4.2 Form of Subcontract

4.2.1 All Subcontracts shall be on the **State of Ohio Subcontract Form** prescribed by OAC Section 153:1-03-02.

4.3 Replacement of Subcontractors

4.3.1 The Contractor shall not replace any Subcontractor after execution of the Subcontract without the prior written approval of the Contracting Authority.

4.4 Contractor's Responsibility

4.4.1 The Contractor is fully responsible for all acts and omissions of its Subcontractors and is responsible for scheduling and coordinating the Work of its Subcontractors.

4.4.1.1 The Contractor is fully responsible for any delay, interference, disruption, or hindrance attributable to its Subcontractors.

4.4.1.2 The Contractor shall require each of its Subcontractors to have a competent supervisor at the Site whenever the Subcontractor is performing Work.

4.4.1.3 The Contractor shall bind its Subcontractors to the terms of the Contract Documents, so far as applicable to the Work of the Subcontractor.

4.4.1.4 The Contractor shall not agree to any provision, which seeks to bind the State to terms inconsistent with or at variance from the Contract Documents.

4.4.2 The Contractor will not be relieved of its full responsibility for Subcontractors and their performance of the Work by **(1)** the participation of the Owner, Contracting Authority, and A/E in the processes described under this **Article 4** or other related provisions of the Contract Documents or **(2)** the Contracting Authority's rejection of a Subcontractor or failure to reject a Subcontractor under **Section 4.1**.

4.5 Contingent Assignment of Subcontracts

4.5.1 The Contractor hereby assigns its agreement with each Subcontractor to the Contracting Authority provided that the assignment is effective only after termination of the Contract in whole or in part by the Contracting Authority and only for those agreements that the Contracting Authority accepts by notifying the Contractor and applicable Subcontractors in writing. The Contracting Authority may re-assign accepted agreements.

4.5.1.1 If the Contracting Authority terminates the Contract in part, the Contracting Authority may **(1)** take assignment of any entire Subcontract affected by the termination or **(2)** take partial assignment of only the portion of any Subcontract associated with the terminated part of the Contract.

4.6 Prompt Payment

4.6.1 The Contractor shall make payments to Subcontractors in accordance with Applicable Law, including ORC Sections 153.12 and 4113.61.

4.6.2 The Contractor may reduce the amount paid to a Subcontractor pursuant to **Section 4.6.1** at a rate equal to the percentage retained from the Contractor and may withhold amounts necessary to **(1)** resolve disputed liens or claims involving the Work of the Subcontractor or **(2)** account for the failure of the Subcontractor to perform its obligations under its agreement with the Contractor.

ARTICLE 5 - PRECONSTRUCTION ACTIVITIES

5.1 Neutral Facilitation

5.1.1 The Contracting Authority or Owner may engage a Neutral Facilitator for the purposes of **(1)** building cooperative relationships among the Project participants to achieve discrete objectives; **(2)** encouraging educated, productive, and expedited attempts to avoid, minimize, and resolve disputes; and **(3)** maximizing the effectiveness of each participant's resources.

5.1.1.1 For example, a Neutral Facilitator may facilitate a preconstruction organizational meeting, a partnering session, or efforts to resolve disputes throughout the Project, all of which the Contractor shall participate in at the Contracting Authority's request. The Contractor's compensation for participating in those meetings, sessions,

efforts, and related activities is included in the Contract Sum, and the Contractor will not be entitled to an increase of the Contract Sum for participating as requested.

5.1.2 The Contracting Authority, Owner, and Contractor are entitled to interact with the Neutral Facilitator with the full expectation that **(1)** they may act, speak, and disclose information with complete candor and **(2)** all communication, whether oral or written, made in the course of facilitated sessions is confidential.

5.1.3 At any hearing or proceeding regarding any dispute arising out of or related to the Project **(1)** the Neutral Facilitator will not be competent to testify and shall not be called as a witness and **(2)** the Neutral Facilitator's testimony and work product will not be admissible.

5.1.4 The Neutral Facilitator will not **(1)** perform any services with respect to or bear any responsibility for any legal services, design-professional services, construction, or construction management associated with the Project or **(2)** have any liability whatsoever for any claims related to any legal services, design-professional services, construction, or construction management associated with the Project, including without limitation, claims for legal or design-professional errors or omissions, delays, cost overruns, faulty construction, or increased costs.

5.1.5 The Neutral Facilitator's participation in the Project will not relieve the Contracting Authority, Owner, and Contractor of any of their respective rights or obligations under the Contract.

5.2 Building and Trade Permits and Licenses

5.2.1 Plan Approval.

5.2.1.1 The A/E shall secure the required structural, plumbing, HVAC, and electrical plan approvals.

5.2.1.2 The Contractor shall schedule and attend all intermediate and final inspections required for any permit applicable to the Work. The Contractor shall schedule the State Fire Marshal or local fire authority for the life safety inspection for occupancy permits. The Contractor shall give the A/E, Contracting Authority, and Owner reasonable notice of the dates and times arranged for inspections.

.1 The Contractor shall pay for any reinspections required as a result of the Contractor's failure to receive approval of its Work, unless the reinspection is required because the design does not comply with Applicable Law.

5.2.2 Trade Permits and Licenses.

5.2.2.1 The Contractor shall obtain, maintain, and pay for any permit, inspection, or license applicable to the Contractor's particular trade.

5.2.3 Local Permits.

5.2.3.1 The Contractor shall secure and pay the fees for any permits, inspections, licenses, capacity charges, or tap fees required by local authorities having jurisdiction over the Project. The Contractor shall give the A/E, Contracting Authority, and Owner reasonable notice of the date arranged for inspections.

5.2.4 National Pollutant Discharge Elimination System ("NPDES") Storm Water General Permit.

5.2.4.1 The A/E shall secure the NPDES general permit by submitting a Notice of Intent ("NOI") application form to the Ohio Environmental Protection Agency at least 45 days prior to the start of construction. The Contractor shall be a "co-permitee" if required under Applicable Law.

5.2.4.2 The A/E shall prepare and certify a storm water pollution prevention plan to provide sedimentation and erosion controls at the Project.

5.2.4.3 The A/E shall prepare and process the required Notice of Termination ("NOT") prior to Contract Completion.

ARTICLE 6 - CONSTRUCTION AND CLOSEOUT

6.1 Commencement of Work on the Site

6.1.1 The Construction Stage will start and the Contract Times will begin to run on the Date of Commencement established in a Notice to Proceed, which the Contracting Authority will issue to the Contractor. The date on which the Contracting Authority issues the Notice to Proceed **(1)** is not relevant to the running of the Contract Times, and **(2)** may differ from Date of Commencement. Unless the Contracting Authority agrees otherwise in writing, the Contractor shall begin to perform the Work within seven days after the Date of Commencement and thereafter diligently prosecute the Work. The Construction Stage terminates upon Contract Completion.

6.2 Contractor's General Responsibilities

6.2.1 The Contractor shall **(1)** maintain a competent, full-time staff at the Site at all times that Work is in preparation or progress on the Project, **(2)** shall supervise the Work; **(3)** establish and implement on-Site organization and authority so that the Work is accomplished in conformance with the Project Schedule; and **(4)** complete portions of the Work in the sequence and time in the Construction Progress Schedule.

6.2.2 The Contractor shall perform the Work so as not to interfere with, disturb, hinder, or delay the services of Separate Consultants or the work of Separate Contractors. The Contractor shall cooperate and coordinate fully with all Separate Consultants and Separate Contractors and shall freely share all of the Contractor's Project-related information with them to facilitate the timely and proper performance of the Work and of the services and work of the Separate Consultants and Separate Contractors.

6.2.3 The Contractor shall afford every Separate Consultant and Separate Contractor proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of their services and work.

6.2.4 If the Contractor damages the property or work of any Separate Consultant or Separate Contractor, or by failure to perform the Work with due diligence, delays, interferes with, hinders, or disrupts the services of any Separate Consultant or the work of any Separate Contractor who suffers additional expense and damage as a result, the Contractor is responsible for that damage, injury, or expense.

6.2.5 The intent of **Sections 6.2.2** through **6.2.4** is to benefit the Separate Consultants and Separate Contractors, and to demonstrate that the Separate Consultants and Separate Contractors are intended third-party beneficiaries of the Contractor's obligations under the Contract.

6.2.6 If the proper execution or results of any part of the Work depends upon work performed or services provided by the Owner, a Separate Consultant, or a Separate Contractor, the Contractor shall inspect that other work and appropriate instruments of service, and promptly report to the Contracting Authority in writing any defects or deficiencies in that other work or services that render it unavailable or unsuitable for the proper execution and results of the Work. The Contractor's failure to report before starting the affected part of its Work will constitute an acceptance of the other work and services as fit and proper for integration with the Contractor's Work except for defects and deficiencies in the other work or services that were not reasonably discoverable at the time of the Contractor's inspection.

6.2.7 The Contractor shall not delay the Work on account of any claim, dispute, or action between the Contractor and a Separate Consultant or Separate Contractor.

6.2.8 The Contractor shall develop and keep current the Construction Progress Schedule in accordance with **Section 6.5**, and prepare and keep current a schedule of submittals that is coordinated with the Construction Progress Schedule, for the A/E and Contracting Authority's acceptance.

6.2.9 The Contractor shall monitor the progress of the Work for conformance with the Construction Progress Schedule and shall initiate revisions as required by **Section 6.5.6**.

6.2.10 The Contractor shall establish the Project's regular working hours, subject to approval by the A/E and the Owner.

6.2.11 The Contractor shall coordinate the Work with the activities and responsibilities of the A/E, Owner, and Contracting Authority to complete the Project in accordance with the Contract Documents.

6.2.12 In the event of default of the Contractor, the Contractor shall cooperate with the A/E, Owner, Contracting Authority, and Contractor's Surety to achieve the Substantial Completion date and Contract Completion.

6.2.13 The Contractor shall remove all snow and ice as may be required for reasonably safe access to the Project including, but not limited to, building entries, driveways, parking lots, and sidewalks.

6.2.14 The Contractor shall keep a daily log containing a record of weather, number of workers on Site, identification of equipment, Work accomplished, problems encountered, and other similar relevant data.

6.3 Construction Procedures

6.3.1 The Contractor is solely responsible for and has control over all construction means, methods, manners, techniques, sequences, and procedures, for safety precautions and programs in connection with the Work, and for coordinating all portions of the Work.

6.3.1.1 If the Contract Documents give instructions that affect construction means, methods, manners, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety of them and, except as stated below, shall

be fully and solely responsible for the jobsite safety of the means, methods, manners, techniques, sequences, or procedures.

6.3.1.2 If the Contractor determines that the means, methods, manners, techniques, sequences, or procedures specified in the Contract Documents may not be safe, the Contractor shall give timely written notice to the A/E, Owner, and Contracting Authority. The Contractor shall not proceed with that portion of the Work without further written instructions from the A/E. Any modification of the Contract shall be in accordance with **Article 7**.

6.3.2 The Contractor shall lay out and coordinate all lines, levels, elevations, and measurements for all of the Work, coordinate and verify existing conditions, and notify the A/E of discrepancies and conflicts before proceeding with installation or excavation.

6.3.3 The Contractor shall perform all cutting, fitting, or patching required for the Work and shall not endanger the Project by cutting, excavating, or otherwise altering the Project, or any part of it.

6.3.3.1 If the Contractor requires sleeves for the Work, the Contractor shall furnish and install the sleeves. The Contractor is responsible for the exact location and size of all holes and openings required to be formed or built for the Work.

6.3.3.2 The Contractor's patching shall match and blend with the existing or adjacent surface(s).

6.3.4 The Contractor shall comply with ORC Sections 3781.25 through 3781.32. In addition, before starting excavation or trenching, the Contractor shall determine the location of any underground utilities and notify any public authority or utility having jurisdiction over the Project and secure any required approval.

6.3.5 The Contractor shall install all Work in accordance with the Contract Documents and any installation recommendations of the manufacturer, including required temperature and humidity limits for installation of the various materials.

6.3.6 The Contractor shall comply with all requirements and conditions of the NPDES general permit, including, but not limited to, implementing and maintaining the sedimentation and erosion control measures specified in the storm water pollution prevention plan prepared by the A/E pursuant to **Section 5.2.4**, which are related to the Work, maintaining records of its construction activities, removing materials no longer required, and taking proper action if there is a reportable quantity spill.

6.3.7 The Contractor shall communicate with the Contracting Authority and Owner through the A/E.

6.4 Construction Supervision

6.4.1 Unless waived by the Contracting Authority in writing, the Contractor shall provide continuous supervision at the Site by a competent superintendent when any Work is being performed, and the Contractor's superintendent shall not be involved with any work other than the Project.

6.4.2 The Contractor's project manager and superintendent shall each have the responsibility and authority to act on behalf of the Contractor. All communications to the Contractor's project manager or superintendent shall be binding as if given directly to the Contractor.

6.4.3 Within ten days after the Date of Commencement, the Contractor shall submit to the Contracting Authority an outline of the qualifications and experience of the Contractor's proposed project manager and proposed superintendent, including references. Upon receiving a request from the Contracting Authority, the Contractor shall submit to the Contracting Authority an outline of the qualifications and experience of any Subcontractor's proposed project manager and proposed superintendent.

6.4.3.1 The Contracting Authority may reject the Contractor's or Subcontractor's proposed project manager or proposed superintendent. If the Contracting Authority does not notify the Contractor of the rejection within 30 days after receiving the required information, it shall indicate that the Contracting Authority has no objection, but does not affect the Contracting Authority's rights under **Section 6.12.2** or any other provision relative to that project manager or superintendent.

6.4.3.2 If the Contracting Authority rejects the Contractor's or Subcontractor's proposed project manager or proposed superintendent, the Contractor shall replace, or cause the Subcontractor to replace the project manager or superintendent (as appropriate) with someone acceptable to the Contracting Authority at no additional cost.

6.4.4 The Contractor and its Subcontractors shall not replace their respective project managers or superintendents without prior written approval of the Contracting Authority.

6.4.4.1 If the Contractor or a Subcontractor proposes to change its project manager or superintendent, the Contractor shall submit written justification to the Contracting Authority, along with the name and qualifications of the proposed replacement.

6.4.4.2 The procedure provided in **Section 6.4.3** shall be conducted to evaluate the Contractor's or Subcontractor's (as applicable) proposed replacement project manager or superintendent.

6.5 Construction Progress Schedule

6.5.1 General Requirements

6.5.1.1 The Contractor shall prepare and maintain the Construction Progress Schedule using the critical path method of scheduling and commercially available computer software acceptable to the Contracting Authority.

.1 In the Construction Progress Schedule, the Contractor shall **(1)** organize all Work activities into a logical work breakdown structure; **(2)** set forth a reasonable, efficient, economical, and practical plan to complete the Work within the Contract Times, and **(3)** convey the prosecution and progress of the Work in a manner that accounts for **(a)** normal adverse weather, as defined under **Section 7.10**, through reasonably anticipated productivity variations for weather-sensitive activities, **(b)** Legal Holidays, and **(c)** similar reasonably anticipated events.

6.5.1.2 The Contractor shall use the most-current, accepted Construction Progress Schedule **(1)** to plan, organize, execute, and manage the Work using early start dates and early finish dates; **(2)** to record and report actual performance and progress of the Work; **(3)** to show how it plans to coordinate and complete all remaining Work within applicable Milestones; and **(4)** as the basis for requests for extensions of the Contract Times.

6.5.1.3 The Project participants will use the Construction Progress Schedule as a tool for scheduling and reporting sequenced progress of the Work.

6.5.1.4 The Contracting Authority's, Owner's, or A/E's review, acceptance, or approval of any Construction Progress Schedule will not **(1)** relieve the Contractor of any of the Contractor's responsibilities under the Contract including the responsibility to perform the Work in accordance with the Construction Progress Schedule and within the Contract Times, or **(2)** imply, warrant, or acknowledge the reasonableness or accuracy of the logic, durations, cost, resource loading, or any other attributes of the Construction Progress Schedule.

6.5.1.5 The Contracting Authority may withhold payment from the Contractor on account of the Contractor's failure to prepare, maintain, or update the Construction Progress Schedule as required under the Contract.

6.5.2 Submission Requirements

6.5.2.1 The Contractor shall provide each submission of the Construction Progress Schedule **(1)** as a Gantt chart in PDF; **(2)** as a Gantt chart in hardcopy if the Contracting Authority requests; and **(3)** an Electronic File.

.1 The hardcopy format for the Construction Progress Schedule shall be 11x17 inch.

.2 The Electronic File of the Construction Progress Schedule shall be in .xer, .xml, or .mpp format.

6.5.2.2 At the Contracting Authority's request, the Contractor shall prepare and submit to the Contracting Authority reports produced through the scheduling software (collectively "Schedule Reports").

.1 Unless the Contracting Authority requests otherwise, the Contractor shall submit each Schedule Report in Electronic File format, PDF format, and 8.5x11 hardcopy format.

6.5.3 Schedule Information Requirements

6.5.3.1 General Requirements. The Contractor shall include at least the following information in the Construction Progress Schedule:

.1 a clear graphics legend;

.2 the Contracting Authority's Project number and Project name;

.3 a graphic presentation of the sequence of all of the Work;

.4 identification of each stage of the Work and any Milestone dates;

.5 identification of activities and durations for **(1)** entering into each Subcontract with an anticipated value in excess of 10% of the Construction Budget or as otherwise requested by the Contracting Authority; **(2)** preparation, review, and approval of Shop Drawings and other action submittals; **(3)** fabrication and review of mock-up Work; **(4)** product review and procurement, fabrication, shop inspection, and delivery, including, but not limited to, lead time and coordination drawing delivery; **(5)** Date of Commencement identified as "Start Milestone"; **(6)** date(s) of Substantial Completion identified as "Finish Milestone"; **(7)**

Punch List development; **(8)** Punch List correction; **(9)** Project close-out requirements; **(10)** occupancy requirements; and **(11)** Contract Completion;

.6 for each activity:

1. Activity ID, Activity Description, and Calendar ID;

2. identification of the single organization responsible for performing the activity;

3. early start, early finish, late start, late finish, duration, and total float;

4. in other than the baseline Construction Progress Schedule: original duration, remaining duration, and percentage of completion;

5. identification of predecessor and successor activities, constraints, and percentage of completion; and

6. a maximum duration that is appropriate for the activity but not in excess of 15 days except **(1)** non-construction activities such as procurement of materials, delivery of equipment, concrete curing, etc.; and **(2)** other activities for which the Contracting Authority may approve a longer duration;

.7 identification of disruptions and shutdowns due to other operations;

.8 identification of all planned work hours for each Work Day;

.9 identification of the longest path of the Work (in red) and all critical paths of the Work;

.10 identification of the crew size and total resource hours for each activity in the schedule;

.11 other items required by the Contracting Authority, Owner, or A/E; and

.12 the Contractor's signature approval and date lines, which the Contractor shall complete indicating approval of each submitted schedule.

6.5.3.2 Activity Identifications ("ID")

.1 Activity ID's shall follow the naming convention agreed upon between the Contracting Authority and the Contractor before the Contractor begins to prepare the baseline Construction Progress Schedule.

.2 Each Activity ID for a specific Activity Description shall remain unchanged and connected to its original Activity Description throughout the Project.

6.5.3.3 Activity Descriptions

.1 Each activity shall have a clear and concise Activity Description..

6.5.3.4 Activity Relationships

.1 All activities except Date of Commencement shall have at least one predecessor, and all activities except Contract Completion shall have at least one successor.

.2 To link activities, the Contractor may use **(1)** finish-to-start relationships with no leads or lags; **(2)** start-to-start relationships with lags no greater than the predecessor duration; or **(3)** finish-to-finish relationships when both activities are already aligned with a start-to-start relationship.

6.5.3.5 Project Level Activity Codes

.1 For each activity, the Contractor shall assign responsibility to an identified, single performing organization.

6.5.3.6 Project Level Calendars

.1 The Contractor shall create and maintain calendars at the project level.

6.5.3.7 No Global Data

.1 The Contractor may not use global data of any kind (e.g., codes, calendars, etc.).

6.5.3.8 Float and Critical Activities

.1 "Float" is the amount of time between the early start date and the late start date (or the early finish date and the late finish date) for each activity. Float is for the benefit of both the Contracting Authority and the Contractor; i.e., float is not for the Contractor's exclusive benefit. Either the Contracting Authority or the Contractor may use float on a first-come-first-served basis without cost impact. The Contractor may not suppress or consume float by artificially extending activity durations, creating dummy activities, or applying preferential sequencing.

1. The Contractor shall exhaust existing float before claiming additional time for a Modification, or show that it is not possible to use float to cover the time requirements of the Modification.

2. The Contractor may not suppress or sequester float through, for example, artificial/illogical sequencing, excessive durations, date constraints, float constraints, improper use of lag, or calendar manipulation.

.2 "Critical Activities" are activities **(1)** occurring on the longest path through the Construction Progress Schedule; or **(2)** with float of less than one day; or **(3)** both. The Contractor shall monitor and diligently pursue any activities with ten or fewer days of total float.

6.5.4 Baseline Construction Progress Schedule

6.5.4.1 Unless the Contracting Authority and Contractor agree otherwise, within 45 days after the execution of the Agreement, the Contractor shall submit to the Contracting Authority and A/E a fully developed, baseline Construction Progress Schedule in compliance with this **Section 6.5** that demonstrates the longest path and all critical paths for all of the Work.

.1 The Contracting Authority's approval of the baseline Construction Progress Schedule is a condition precedent to the Contractor's entitlement to payment under the Contract.

6.5.4.2 The Contractor shall develop the baseline Construction Progress Schedule based upon **(1)** the Contract Times defined in the Agreement, and **(2)** the schedule information included in the Bidding Documents.

6.5.4.3 In the event of a significant change or combination of changes, as determined by the Contracting Authority in its discretion, the Contracting Authority may identify a Contracting Authority-approved, updated or revised Construction Progress Schedule as the new baseline Construction Progress Schedule for future updates and reports.

6.5.5 Monthly Construction Progress Schedule Updates

6.5.5.1 The Contractor shall include a monthly Construction Progress Schedule update as a component of each of the Contractor's Progress Status Reports.

6.5.5.2 The Contractor shall generate monthly Construction Progress Schedule updates based upon and relative to the Contracting Authority-approved baseline Construction Progress Schedule and using retained logic (as opposed to logic override) to reflect and include:

.1 the actual progression and sequence of the Work;

.2 actual and projected start and completion dates;

.3 actual Modifications; and

.4 the longest path of the Work and all critical paths of the Work.

6.5.5.3 The Contractor shall use the first date of the next month at 12:01 a.m. as the data date for calculating the monthly Construction Progress Schedule update (e.g., progress through March will have a data date of April 1 @ 12:01 am).

6.5.5.4 The Contractor shall accurately input actual start and actual completion dates and correct all logic errors. If the Contractor changes/corrects any actual dates in any following month, the Contractor shall clearly identify the change/correction and provide a written explanation for it.

6.5.5.5 If the Contracting Authority requests, the Contractor shall include with each monthly Construction Progress Schedule update any of the associated Schedule Reports produced by the scheduling software.

6.5.5.6 The Contractor's submission of a monthly Construction Progress Schedule update shall serve as an affirmation that the Contractor intends to and is capable of performing the Work consistent with the associated monthly Construction Progress Schedule update.

6.5.5.7 The Contracting Authority and the A/E will review and may approve or reject and return the monthly Construction Progress Schedule update to the Contractor with recommendations for revisions.

6.5.6 Revised Construction Progress Schedules

6.5.6.1 Unless and until the Contracting Authority agrees in writing, the Contractor shall not change any of the accepted activities, activity durations, schedule logic, interdependencies, Milestones, planned sequence of operations, or resource loading set forth in the Construction Progress Schedule.

6.5.6.2 Once the Contracting Authority accepts a Modification involving Construction Progress Schedule changes (including no-cost time extensions such as on account of excessive weather days and other excusable delays), but not before then, the Contractor shall promptly incorporate the associated activity, duration, and logic changes, additions, combinations, eliminations, or other modifications into the then-current Construction Progress Schedule and submit for the Contracting Authority's approval **(1)** that revised Construction Progress Schedule; and **(2)** if the Contracting Authority requests, any of the associated Schedule Reports produced by the scheduling software.

6.5.6.3 If the Contractor incurs an inexcusable delay, the Contractor shall promptly incorporate any associated activity, duration, and logic changes, additions, combinations, eliminations, or other modifications into the then-current Construction Progress Schedule and submit for the Contracting Authority's approval **(1)** that revised

Construction Progress Schedule; and **(2)** if the Contracting Authority requests, any of the associated Schedule Reports produced by the scheduling software. The Contracting Authority's approval will not constitute an extension of the Contract Times due to the inexcusable delay.

6.5.6.4 The Contractor's submission of a revised Construction Progress Schedule shall serve as an affirmation that the Contractor intends to and is capable of performing the Work consistent with the associated revised Construction Progress Schedule update.

6.5.6.5 If the Contracting Authority and the Contractor cannot reach agreement on Construction Progress Schedule modifications resulting from a Modification or inexcusable delay, and the Contracting Authority requests, the Contractor shall prepare and submit a time-impact analysis when and as described under **Section 7.9.3**.

6.5.7 Short-Interval Schedules and Weekly Schedule Reports

6.5.7.1 A "Short-Interval Schedule" is a three- to four-week (past week, current week, and the next one to two weeks) schedule window that **(1)** breaks down existing schedule activities into smaller and more-manageable components with relatively short durations; and **(2)** is consistent with the then-current Construction Progress Schedule.

6.5.7.2 On a weekly basis, and no less than 24 hours before the next regularly scheduled Progress Meeting, the Contractor shall prepare and submit a Short-Interval Schedule to the A/E. The Contractor shall present and be prepared to discuss the Short-Interval Schedule during that Progress Meeting, and the A/E shall attach the Short-Interval Schedule to the minutes of that Progress Meeting.

6.5.8 Recovery Plan and Revised Construction Progress Schedule

6.5.8.1 If it is apparent to the Contracting Authority or A/E that the Contractor may be unable to meet critical path activities, Milestone completion dates, or the Substantial Completion date(s); the A/E shall direct the Contractor to submit within three days a recovery plan to avoid or minimize delay to the Project.

6.5.8.2 A recovery plan shall include, but is not limited to, adjustments to the following:

- **.1** workforce;
- **.2** hours per shift;
- **.3** shifts per workday;
- **.4** workdays per week;
- **.5** material and equipment procurement; and
- **.6** activity logic.

6.5.8.3 The Contractor's submission of a recovery plan shall serve as an affirmation that the Contractor **(1)** prepared the recovery plan in consultation with its Subcontractors, and **(2)** intends to and is capable of performing the Work consistent with that recovery plan.

6.5.8.4 If the Owner and Contracting Authority approve the recovery plan, within seven days after the plan approval, the Contractor shall incorporate that plan into a revised Construction Progress Schedule which the Contractor shall prepare and submit for review and approval in accordance with **Section 6.5.6**. If the Owner and Contracting Authority do not approve the recovery plan, the Contractor shall submit an alternate recovery plan within three days.

6.5.9 Small-Project Exceptions

6.5.9.1 This **Section 6.5** applies to a Small Project, which is a Project for which the initial Contract Sum is less than $500,000, except as explicitly provided in this **Section 6.5.9.**

6.5.9.2 In lieu of **Section 6.5.2**, the Contractor shall provide each submission of the Construction Progress Schedule **(1)** as a Gantt chart in PDF; **(2)** as a Gantt chart in hardcopy if the Contracting Authority requests; and **(3)** an Electronic File in its native format.

6.5.9.3 In lieu of **Section 6.5.3**, the Contractor shall include at least the following information in the Construction Progress Schedule:

- **.1** a clear graphics legend;
- **.2** the Contracting Authority's Project number and Project name;
- **.3** identification of each stage of the Work and any Milestone dates;
- **.4** identification of activities and durations for **(1)** date(s) of Substantial Completion; **(2)** Project close-out requirements; and **(3)** and Contract Completion;
- **.5** for each activity, a maximum duration that is appropriate for the activity but not in excess of 15 days;
- **.6** other items required by the Contracting Authority, Owner, or A/E; and

.7 the Contractor's signature approval and date lines, which the Contractor shall complete indicating approval of each submitted schedule.

6.5.9.4 In lieu of **Section 6.5.4.1**, unless the Contracting Authority and Contractor agree otherwise, within 15 days after the execution of the Agreement, the Contractor shall submit to the Contracting Authority and A/E a fully developed, baseline Construction Progress Schedule in compliance with this **Section 6.4.**

6.5.9.5 In lieu of **Section 6.5.5.2,** the Contractor shall generate monthly Construction Progress Schedule updates based upon and relative to the Contracting Authority-approved baseline Construction Progress Schedule to reflect and include **(1)** the actual progression and sequence of the Work; **(2)** actual and projected start and completion dates; and **(3)** actual Modifications.

6.5.9.6 The Contractor may, but is not obligated to comply with **Sections 6.5.3.4**, **6.5.3.5**, **6.5.3.6**, **6.5.3.7**, **6.5.5.3**, **6.5.5.4**, and **6.5.5.5**.

6.6 Progress Meetings

6.6.1 The A/E shall schedule a weekly progress meeting for the Contractor and other Persons involved in the Project. The purpose of the progress meeting is to review progress on the Project during the previous week, discuss anticipated progress during the following weeks, review critical operations, and discuss critical problems.

6.6.2 The Contractor shall be represented at every progress meeting by a Person authorized with signature authority to make decisions regarding possible modification of the Contract Documents or Construction Progress Schedule.

6.6.2.1 The A/E shall notify the Contractor and other Persons involved in the Project of the time and place of the progress meeting that shall thereafter be the same day and hour of the week for the duration of the Project, unless the A/E notifies the Contractor and other Persons involved in the Project of a different day and hour at least two days in advance.

6.6.2.2 The Contractor shall have any of its Subcontractors attend the progress meeting as determined advisable by the Contractor, or as requested by the A/E.

6.6.3 The A/E shall prepare a written report of each progress meeting and distribute the report to the Contracting Authority, Owner, and Contractor. The A/E shall not delegate the duty to prepare a written report of any progress meeting.

6.6.3.1 If any Person in attendance objects to anything in a report of a progress meeting, the Person shall notify the A/E, Contracting Authority, and any other affected Person in writing explaining the objection within five days.

6.6.3.2 The report of each progress meeting shall reflect any objection made to the report of the previous progress meeting and any response.

6.7 Project Coordination

6.7.1 The Contractor shall prepare drawings ("Coordination Drawings") after the Contractor and appropriate Subcontractors ("Coordination Participants") **(1)** determine the sequence of the Project, **(2)** identify the areas requiring special attention ("Coordination Areas"), and **(3)** determine the need for a coordination drawing for any Coordination Area. The Contractor shall prepare the Coordination Drawings with Computer-Aided Design ("CAD") or BIM software acceptable to the Contracting Authority. The Coordination Drawings shall show the sheet metal work with plan and elevation dimensions, which specifically locate all HVAC ductwork, HVAC equipment, and HVAC piping for each Coordination Area based upon the information, discussion, and resulting consensus of the Coordination Participants.

6.7.1.1 After the Contractor completes the Coordination Drawings, the Contractor shall forward a copy of the Coordination Drawings to the A/E, Contracting Authority, and Owner.

6.7.1.2 The A/E shall review the Coordination Drawings to determine whether the Coordination Participants achieved the goals listed in **Section 6.7.1**. The A/E shall report any concerns, in writing, to the Coordination Participants within 14 days after receiving the drawings.

6.8 Review of Contract Documents and Field Conditions

6.8.1 Before starting each portion of the Work, the Contractor shall carefully study and compare the various Contract Documents relative to that portion of the Work, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the Site affecting it.

6.8.2 If the Contractor finds any perceived ambiguity, conflict, error, omission, or discrepancy on or between any of the Contract Documents, or between any of the Contract Documents and any Applicable Law, the Contractor, before proceeding with the Work, shall promptly submit a RFI to the A/E for an interpretation or clarification.

6.8.2.1 Before submitting any RFI to the A/E, the Contractor shall carefully review the Contract Documents to ensure that the Contract Documents do not answer the RFI.

6.8.2.2 The A/E shall promptly respond to each RFI.

6.8.2.3 Any interpretation or clarification of the Contract Documents made by any Person other than the A/E, or in any manner other than writing, shall not be binding and the Contractor shall not rely upon it.

6.8.3 If the Contractor believes that it is entitled to an adjustment of the Contract Sum or Contract Times, or both, on account of clarifications or instructions issued by the A/E in response to a RFI, the Contractor shall initiate a Change Request **(1)** as required under **Section 7.6**, and **(2)** within the time period under **Section 7.6**, which begins to run on the day that the Contractor receives the A/E's RFI response.

6.9 Differing Site Conditions

6.9.1 If the Contractor reasonably believes that it has encountered a Differing Site Condition, the Contractor shall immediately stop Work on that suspected Differing Site Condition and verbally report the condition to the Contracting Authority and A/E, and within one business day deliver written notice of the condition to the Contracting Authority and A/E.

6.9.1.1 The Contractor's failure to give notice of the Differing Site Condition as required under this **Section 6.9** will constitute an irrevocable waiver of any associated Claim.

6.9.1.2 The written notice of a Differing Site Condition under this **Section 6.9** shall be required before submission of a Change Request under **Section 7.6** or notice of Claim under **Article 8**.

6.9.2 Promptly after receiving notice from the Contractor under **Section 6.9.1**, the A/E shall investigate to determine whether the Contractor has encountered a Differing Site Condition. The A/E shall give written notice of its determination to the Contracting Authority and Contractor within ten days after completing the investigation.

6.9.2.1 If the A/E determines that the Contractor has encountered a Differing Site Condition and the Contracting Authority and Contractor agree with the A/E's determination, the A/E shall process an associated Change Order or Change Directive as appropriate.

6.9.2.2 If the A/E determines that the Contractor has encountered a Differing Site Condition, but the Contracting Authority disagrees with the A/E's determination, the A/E shall process an associated Change Directive through which the Contracting Authority may convey its disagreement with the A/E's determination.

6.9.2.3 If the A/E determines that the Contractor has not encountered a Differing Site Condition and the Contractor does not agree with that determination, the Contractor shall initiate a Change Request **(1)** as required under **Section 7.6**; and **(2)** within the time period required under **Section 7.6** which begins to run on the day that the A/E issues its determination.

6.10 Protection of the Project

6.10.1 The Contractor shall protect the Work from weather and maintain the Work and all materials, apparatus, and fixtures free from injury or damage until Substantial Completion of the Work.

6.10.1.1 The Contractor shall at all times cover or protect the Work.

6.10.1.2 The Contractor, at its expense, shall remove, and replace with new, any Work damaged as a result of the Contractor's failure to provide coverage or protection.

6.10.1.3 The Contractor, at its expense, shall repair or replace any adjacent property, including, but not limited to, roads, walks, shrubbery, plants, trees, or turf, damaged during performance of the Contract.

6.10.1.4 After the date of Substantial Completion of the Work, the Owner is responsible for protecting and maintaining all materials, apparatus, and fixtures for the occupied portion of the Project free from injury or damage.

6.10.2 The Contractor shall protect the Project and existing or adjacent property from damage at all times and shall erect and maintain necessary barriers, furnish and keep lighted necessary danger signals at night, and take reasonable precautions to prevent injury or damage to individuals or property.

6.10.3 The Contractor shall not load, or permit any part of the Project to be loaded, in any manner that endangers the Project, or any portion thereof. The Contractor shall not subject any part of the Project or existing or adjacent property to stress or pressure that endangers the Project or property.

6.10.4 The Contractor shall provide all temporary bracing, shoring, and other structural support required for safety and proper execution of the Work.

6.10.5 Vibration, Noise, and Dust Control.

6.10.5.1 The Contractor shall provide controls/barriers for vibrations, noise, and dust control in occupied buildings as required by the construction operations.

6.10.5.2 The Contractor will not be permitted to exhaust or release unfiltered air, dust, construction debris, or other undesirable products into the exterior atmosphere or into occupied areas of the building outside the Site. The Project Manager may limit or stop the Work if the Contractor does not maintain proper air-quality standards.

6.10.5.3 In certain occupied buildings, tasks might be of such a nature that noise and vibration cannot be tolerated. In such spaces, Work shall be scheduled for other than normal working hours. The Contractor is cautioned that weekend or overtime work, if required, shall be performed at no additional cost. The Contractor shall obtain the Contracting Authority's written permission before working other than standard hours. Weekend and overtime Work shall be reflected in the Construction Progress Schedule.

6.10.5.4 The Contractor is responsible for vibration control and control of transmission of noise arising from the Work. Principal considerations that shall be given to noise and vibration control are:

- **.1** Noise control in compliance with Occupational Safety and Health Administration ("OSHA") requirements for the health and safety of building occupants; control shall be for all areas of the facility, including equipment rooms, boiler rooms, and fan rooms.
- **.2** Vibration control to limit sound produced by construction equipment, and for protection of the equipment existing in a building and the building structure.
- **.3** Vibration control to provide for maximum usefulness of the facility by keeping levels of vibration within ranges conducive to study and work or other uses for which the facility is designed.

6.11 Materials and Equipment

6.11.1 The Contractor shall bring to or store at the Site only the materials and equipment required in the Work. If possible, materials and equipment should be installed in their final positions when brought to the Site.

6.11.1.1 The Contractor shall properly store and protect all materials and equipment it provides to the Project.

6.11.1.2 The Contractor shall timely remove from the Site any materials or equipment no longer required for the Work.

6.11.2 The Contractor shall not allow materials or equipment to damage the Project or adjacent property, or to endanger any individual at or near the Site.

6.11.3 If the Contractor provides an Acceptable Component, the Contractor shall be solely responsible for the costs of coordination and modification required.

6.11.4 If the Contractor provides approved Substitutions that require changes to the Contract Documents, the Contractor shall be solely responsible for the additional costs incurred as a result, including, but not limited to, changes to the design by the A/E.

6.11.5 The A/E shall consider Requests for Substitutions after the Bid opening only when the Contractor can conclusively demonstrate to the A/E the following conditions:

6.11.5.1 the specified Basis of Design Components, Acceptable Components, or previously-approved Substitutions, through no fault of the Contractor or a Subcontractor, are not available; or

6.11.5.2 the specified Basis of Design Components, Acceptable Components, or previously-approved Substitutions will not perform as designed or intended.

6.11.6 The Contractor's incorporation of unapproved Substitutions in the Work is Defective Work.

6.12 Labor

6.12.1 The Contractor shall maintain a sufficient workforce and enforce good discipline and order among its employees and the employees of its Subcontractors. The Contractor shall not permit employment of individuals not skilled in tasks assigned to them.

6.12.2 The Contractor shall dismiss from the Project any individual employed by the Contractor, or a Subcontractor, who the Contracting Authority finds, in its sole discretion, to be incompetent, guilty of misconduct, or detrimental to the Project.

6.12.3 The Contractor shall employ all legal efforts to minimize the likelihood or effect of any strike, Work stoppage, or other labor disturbance. Informational pickets shall not justify any Work stoppage.

6.13 Safety Precautions

6.13.1 The Contractor shall take reasonable precautions to ensure the safety of individuals on the Project.

6.13.1.1 The Contractor is responsible for designing and implementing its own safety program, including compliance with OSHA regulations. The Contractor's safety plans, such as fall protection, hazards, communications, competent person, etc., shall meet or exceed the Owner's safety plan (if any).

6.13.2 The Contractor shall pay any fine or cost incurred because of the Contractor's violation, or alleged violation, of Applicable Law.

6.13.3 Before starting any Work, the Contractor shall submit to the Contracting Authority a copy of the Contractor's site-specific safety plan and safety manuals.

6.13.4 The Contractor shall not introduce Hazardous Materials to the Project (other than as specified in the Contract Documents or customary construction materials or equipment) or burn any fires on the Site.

6.13.4.1 If the Contractor brings Hazardous Materials to the Project, the Contractor shall take reasonable precautions to prevent the Hazardous Materials from causing bodily injury or death, property damage, or environmental damage.

6.13.4.2 The Contractor shall notify the Project Manager 24 hours before the start of non-routine or non-recurring hot-work. Use of sources of fire, flame or sparks and flammable materials shall be kept to an absolute minimum. At the beginning of the Project, the Contractor shall inform the Project Manager of its intent to use blowtorches, welding apparatus or similar exposed flame and sparking devices. The Contractor shall give similar notice in regard to the use of flammable liquids, adhesives, and cleaners.

6.13.4.3 The Contractor shall furnish an appropriate number of fire extinguishers (minimum of one), which shall be within the immediate areas where work is being done at all times. The extinguisher(s) shall be adequate and suitable for the class of fire likely to be caused by the Contractor's operations.

6.13.5 Work Stoppage Due to Hazardous Materials.

6.13.5.1 If the Contractor encounters material the Contractor reasonably believes to be or contain, a Hazardous Material that has not been rendered harmless, the Contractor shall immediately stop Work in the affected area and verbally report the condition to the Contracting Authority and A/E, and within one business day deliver written notice of the condition to the Contracting Authority and A/E.

6.13.5.2 The Contracting Authority will promptly determine the necessity of the Owner retaining a qualified environmental consultant to evaluate the suspected Hazardous Material and to issue a related written report. Where appropriate, the Owner will engage a licensed abatement contractor to remove the material or render it harmless as directed.

6.13.5.3 The Contractor shall resume Work in the affected area upon written notice from the A/E that **(1)** the suspect material was evaluated and found not to be or contain a Hazardous Material, or **(2)** the suspect material has been removed or rendered harmless.

6.13.5.4 If the Contractor knowingly or negligently proceeds with the Work in an area where a Hazardous Material exists and has not been rendered harmless, the Contractor shall be solely responsible for all related claims, damages, losses, and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from performing the Work in the affected area.

6.13.5.5 The term "rendered harmless" means that the level of exposure is less than any applicable exposure standards set forth in Applicable Law.

6.13.6 Safety Data Sheets.

6.13.6.1 The Contractor shall identify any material it uses at the Site with a Safety Data Sheet ("SDS") meeting the requirements of OSHA's Hazard Communication Standard.

6.13.6.2 The Contractor shall maintain a notebook containing all of its applicable SDSs. That notebook shall be kept at the Site for the duration of the Project.

6.14 Construction Facilities, Utilities, and Equipment

6.14.1 Facilities.

6.14.1.1 The Contractor shall provide and maintain clean and suitable temporary facilities, equipment, services, and enclosed storage for its use at the Site.

6.14.1.2 The Contractor shall provide and maintain in a clean condition:

.1 suitable facilities, equipment, and services for use by the A/E and Contracting Authority;

.2 adequate space, equipment, furnishings, and services to conduct progress meetings including Wi-Fi internet access and the ability to conduct internet-based video conferences, and a large-format electronic display of suitable scale for the meeting room;

.3 adequate space to store approved documents and permits; and

.4 adequate sanitary facilities for use by all Persons at the Site.

6.14.2 Environmental Controls.

6.14.2.1 The Contractor shall protect its Work and materials from weather and damage from heat, cold, and humidity.

6.14.2.2 Until the permanent HVAC system is complete and available for use:

.1 the Contractor shall make arrangements and pay for installation and maintenance of temporary heating and ventilating systems; and

.2 the Contractor shall pay the costs incurred in operating the temporary heating and ventilating systems.

6.14.2.3 When the permanent HVAC system is complete and available for use:

.1 The Contractor shall start up and maintain operation of the permanent HVAC system, including filters, and promptly remove temporary heating and ventilating systems.

.2 If the Project consists entirely of new construction, the Contractor shall pay the costs of energy consumed in operating the permanent HVAC system until Substantial Completion.

.3 If the Project is a renovation of an existing building or structure, addition(s) to an existing building or structure, or any combination of new construction and renovation work that does not allow separate metering of utilities, the Owner shall pay the costs of energy consumed in operating the permanent HVAC system.

6.14.2.4 From the date of Substantial Completion, the Owner shall pay the cost of operating the permanent HVAC system for the occupied portion of the Project.

6.14.2.5 If the permanent HVAC system is used during construction, the Contractor shall furnish an extended warranty and service contract in effect until the expiration of the Correction Period.

6.14.3 Water and Drainage.

6.14.3.1 The Contractor shall provide water necessary for the Work until the permanent plumbing system is available for use.

6.14.3.2 The Contractor shall provide temporary drainage and dewatering necessary for the Work and shall employ pumps, trenches, drains, sumps, and other necessary elements required to provide satisfactory working conditions for the protection, execution, and completion of the Project.

6.14.3.3 The Contractor shall make arrangements and pay for installation and maintenance of temporary plumbing systems until the permanent plumbing system is available for use.

6.14.3.4 When the permanent plumbing system is complete and available for use:

.1 The Contractor shall start up and maintain operation of the permanent plumbing systems, and make arrangements and pay for removal of temporary plumbing systems.

.2 If the Project consists entirely of new construction, the Contractor shall pay the costs of water consumed and sewerage charges until Substantial Completion.

.3 If the Project is a renovation of an existing building or structure, addition(s) to an existing building or structure, or any combination of new construction and renovation work that does not allow separate metering of utilities, the Owner shall pay the costs of water consumed and sewerage charges.

6.14.3.5 From the date of Substantial Completion, the Owner shall pay the costs of water consumed and sewerage charges for the occupied portion of the Project.

6.14.3.6 If the permanent plumbing system is used during construction, the Contractor shall furnish an extended warranty and service contract in effect until the expiration of the Correction Period.

6.14.4 Electric Service.

6.14.4.1 The Contractor shall provide temporary light and power; and pay the charges for temporary electric service installation and removal if required.

6.14.4.2 If the Project consists entirely of new construction, the Contractor shall pay the cost of energy consumed until Substantial Completion.

6.14.4.3 If the Project is a renovation of an existing building or structure, addition(s) to an existing building or structure, or any combination of new construction and renovation work that does not allow separate metering of utilities, the Owner shall pay the cost of energy consumed.

6.14.4.4 From the date of Substantial Completion, the Owner shall pay the cost of energy consumed for the occupied portions of the Project.

6.14.4.5 If the permanent electrical system is used during construction, the Contractor shall furnish an extended warranty and service contract in effect until the expiration of the Correction Period.

6.14.5 Hoisting Facilities.

6.14.5.1 The Contractor shall erect and maintain any hoisting equipment required for its Work.

6.14.5.2 If the electric service requirements of hoisting facilities differ from that available at the Site, the Contractor shall provide and pay for all necessary connections.

6.14.5.3 If a permanent elevator is identified in the Contract Documents to be used for hoisting materials or personnel during construction, the Contractor shall furnish an extended warranty and service contract in effect until the expiration of the Correction Period.

6.15 Progress Cleaning

6.15.1 The Contractor shall remove all waste materials, rubbish, and mud attributable to the Work to an appropriate disposal location at or near the Site.

6.15.2 The Contractor shall perform weekly broom cleaning of hard flooring surfaces in the area of the Work.

6.15.3 The Contractor shall remove, once each working day or as appropriate for the Project, all waste materials and rubbish from the disposal location at or near the Site.

6.15.4 The Contractor shall remove, as appropriate for the Project or as the A/E or Owner directs, any waste materials or rubbish from areas adjacent to the Project.

6.15.4.1 The Contractor shall dispose of waste materials, rubbish, and construction debris in a lawful manner in approved recycling facilities or landfills.

6.15.5 If the Contractor fails to clean up during the progress of the Work, the Contracting Authority may clean up on behalf of the Contractor and at the Contractor's expense. If the Contractor fails to maintain the areas adjacent to the Project clean and free of waste materials and rubbish, the Contracting Authority may also direct the local jurisdiction responsible for the area to have the area cleaned to its satisfaction at the Contractor's expense.

6.15.5.1 The Contracting Authority may deduct the cleaning costs from payments then or thereafter due the Contractor. If payments then or thereafter due the Contractor are not sufficient to cover those amounts, the Contractor shall immediately pay the amount of the insufficiency to the Owner.

6.15.6 The Contractor shall remove excavated material and spoil to a suitable off-site location approved by the Contracting Authority.

6.15.6.1 If the Owner designates a location on its property for disposal or storage of clean topsoil and/or subsoil in the Contract Documents, the Contractor shall remove such materials to the designated location.

6.16 Use of Premises

6.16.1 The Contractor shall use corridors, stairs, and elevators as designated by the Contracting Authority. The Contractor shall exercise extreme care to not exceed the carrying capacity of elevators or damage the cab interior in any way.

6.16.2 Loitering or wandering through the interior of buildings or exterior grounds outside the limits of the Work will not be permitted.

6.16.3 The Contractor shall confine its apparatus, materials, and the operations of its workers to the limits indicated by Applicable Law and the directions of the A/E or Project Manager.

6.16.4 No signs or advertising of any kind will be permitted on or about the Site, except those appearing on trucks and trailers.

6.16.5 Site Logistics Plan.

6.16.5.1 No later than seven days after the Date of Commencement, the Contractor shall prepare a Site Logistics Plan and submit it to the Contracting Authority and Owner for their review and approval. Through the Site Logistics Plan, the Contractor shall indicate how the Contractor intends to use the Site, and illustrate things such as areas to be used for lay down of material and equipment; office and storage trailer locations; vehicular access gates with ingress and egress routes; locations of wheel wash and concrete truck wash out activities; and offloading and hoisting locations.

6.16.6 Smoking and Tobacco Products.

6.16.6.1 All State buildings are smoke free. Smoking will not be permitted in any indoor area. The ban on tobacco products will be observed in all indoor and outdoor areas and parking areas on all State-owned and -leased property. The Contractor shall enforce these restrictions on any individual employed by the Contractor or a Subcontractor.

6.17 Interruption of Existing Services

6.17.1 Whenever it becomes necessary to interrupt existing services in use by the Owner or its tenants, including but not limited to sewer, water, gas, and steam lines, electric, telephone, and cable service, the Contractor shall continue the associated Work on a non-stop 24-hour per day basis until that Work is completed and the service restored, or at an alternate time required by the Contracting Authority.

6.17.2 Before beginning that Work, the Contractor shall apply in writing to, and receive approval in writing from, the Owner, through the A/E, to establish a time when interruption of the service will cause a minimum of interference with the activities of the Owner and its tenants.

6.18 Explosives and Blasting

6.18.1 The Contractor shall not conduct blasting on, or bring explosives to, the Site without the prior written approval of the Contracting Authority, Owner, and other authorities with jurisdiction.

6.18.2 The Contractor shall perform all blasting, storing, and handling of explosives as required under Applicable Law.

6.18.2.1 The Contractor shall carry appropriate liability insurance coverage, as required by the Contract Documents, for its blasting and explosives storage and handling operations. Immediately upon request, the Contractor shall deliver evidence of that insurance to the Contracting Authority.

6.19 Building Commissioning

6.19.1 If the Project scope includes building commissioning, the Contractor shall participate in the Commissioning Process, as prescribed in the Contract Documents.

6.19.2 The Contractor shall permit the A/E, or a third-party Commissioning Agent ("CxA") if applicable, access to commission performance based equipment, fixtures, and systems (e.g., HVAC, fire protection, smoke evacuation, fume hoods, emergency power, etc.), prior to Substantial Completion.

6.19.3 The A/E, or CxA if applicable, shall promptly notify the Contractor in writing of any deficiency identified during the Commissioning Process.

6.19.4 To facilitate the Commissioning Process, the Contractor shall submit one hard copy and one electronic copy of Operation and Maintenance Manuals for dynamic and engineered systems to the A/E, and CxA if applicable, for approval. That submission shall occur within 30 days following approval of all related Contractor submittals required by the Contract Documents.

6.20 Action Submittals

6.20.1 Submittal Description. Shop Drawings, Product Data, Samples, and other submittals for the A/E's review and action shall be provided by the Contractor for any item required by the Contract Documents but not fully described in the Contract Documents, unless waived by the A/E, and include, but are not limited to:

6.20.1.1 construction of the various parts, method of joinery, type of materials, grade, quality and thickness of materials, alloy of materials, profiles of all sections, reinforcement, method of hanging doors or installing windows, anchorage, and type and grade of finish;

6.20.1.2 capacities, types of materials and performance charts that are pertinent to the materials, and performance charts that are pertinent to the equipment item; and

6.20.1.3 wiring diagrams, control diagrams, schematic diagrams, working and erection dimensions, arrangement, and specifications.

6.20.2 Form of Submittals. The Contractor shall provide a transmittal letter, review and stamp its approval, and transmit the submittals to the A/E in accordance with the submittal schedule established by the A/E and Contractor.

6.20.2.1 The Contractor shall submit a minimum of one reproducible and three copies of Shop Drawings, and a minimum of four copies of any other submittal, except when using the project management software under **Section 2.1.4.2**.

6.20.2.2 The data shown on the Shop Drawings shall be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to communicate to the A/E the materials and equipment that the Contractor proposes to provide.

6.20.2.3 Each Sample shall be identified clearly as to materials, supplier, pertinent data as catalog numbers, the intended use, and other uses as the A/E may require enabling the A/E to review the submittal.

6.20.3 Delegated Design.

6.20.3.1 If the Contract Documents require the Contractor to provide professional design services or certifications by a design professional related to systems, materials, or equipment, the Contractor shall confirm with the A/E the appropriate performance and design criteria that such services shall satisfy. The Contractor shall submit Shop Drawings and other submittals related to the Work designed or certified by the design professional retained by the Contractor to the A/E for review.

6.20.4 Variation from Contract Documents. If the submittals show variations from the requirements of the Contract Documents, the Contractor shall specifically and clearly identify the variations in its letter of transmittal.

6.20.4.1 Variations that may affect the construction quality, cost or timeline shall be submitted by the A/E to the Contracting Authority for review, and if approved, shall be incorporated into the Work by Change Order or an order for a minor change in the Work (as appropriate).

6.20.4.2 The Contractor shall not be relieved of responsibility for deviations from the Contract Documents by the A/E's approval of submittals.

6.20.4.3 Submittals are not Contract Documents. In the event of conflicts between submittals and the Contract Documents, the Contract Documents take precedence and govern the Work.

6.20.5 Contractor's Submittal Review. The Contractor shall review and stamp "approved" all submittals before forwarding them to the A/E. If it is apparent to the A/E that the Contractor has not reviewed the submittals, or has conducted an incomplete review, the A/E may reject the submittals.

6.20.5.1 The Contractor shall field verify conditions as necessary and make corrections of dimensions, locations of various items, encroachments of work of Separate Contractors, or variations from the requirements of the Contract Documents.

6.20.5.2 If required by the Contract Documents or Applicable Law, the Contractor shall have Shop Drawings or other submittals prepared by Persons possessing expertise and experience in an appropriate trade or profession or by a registered architect, professional engineer, or other professional as required under Applicable Law.

6.20.5.3 By approving and submitting submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements, and field construction criteria related to the associated Work, or shall do so, and has checked and coordinated the information contained within the submittals with the requirements of the Work and of the Contract Documents.

6.20.6 A/E's Submittal Review. The A/E shall review submittals for conformity with design intent within 14 days after receiving them or in accordance with the approved submittal schedule, or other period as mutually agreed by the A/E and Contractor. The A/E's review of submittals is to determine if the items covered by the submittals will, after installation and incorporation into the Work, conform to the Contract Documents and be compatible with the design concept of the Project as a functioning whole.

6.20.6.1 The Contractor shall make corrections required by the A/E and resubmit the required number of corrected copies of submittals until approved, which resubmission shall be acted upon by the A/E within 14 days after receiving them, or other period mutually agreed by the A/E and Contractor.

6.20.6.2 When resubmitting corrected submittals, the Contractor shall direct the A/E's attention to revisions made by noting revisions on the resubmittal.

6.20.6.3 The Contractor shall pay all reasonable costs of the A/E, Owner, and Contracting Authority for attendant delay, interference, hindrance, or disruption of the Project due to excessive resubmittals without fault of the A/E, Owner, or Contracting Authority. Resubmittals in excess of two without fault of the A/E, Owner, or Contracting Authority may be determined excessive by the Contracting Authority.

6.20.6.4 The A/E may hold Samples and other submittals used to coordinate finishes, colors, patterns, textures, or other characteristics until submittals for adjacent materials are available. Within seven days after receiving the submittal, the A/E shall issue a written notice to the Contractor stating that the submittal is being held.

6.20.6.5 If coordinating submittals are not received within the period required for action on previously received submittals that are held in accordance with **Section 6.20.6.4**, review of the previously received submittals may be delayed.

6.20.6.6 The A/E's review shall not extend to means, methods, manners, techniques, sequences, or procedures of construction, or to safety precautions or incident programs.

6.20.6.7 The review and approval of a separate item shall not indicate approval of the assembly in which the item functions.

6.20.7 Risk of Nonpayment. The Contractor shall not commence any portion of the Work requiring Shop Drawings, Product Data, Samples, or other submittals until the submittal has been approved by the A/E. If the Contractor starts Work before the A/E's final approval of the submittal, the Contractor does so at its own risk that payment may not be approved by the Contracting Authority or made by the Owner for the related Work.

6.21 Warranty

6.21.1 The Contractor warrants to the Contracting Authority and Owner that all materials and equipment furnished under the Contract shall be new and of good quality unless otherwise required or permitted by the Contract Documents, that the Work shall be free from defects not inherent in the quality required or permitted, and that the Work shall conform to the requirements of the Contract Documents. Work not conforming to those requirements, including Substitutions not properly approved and authorized is Defective Work. If required by the A/E, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

6.21.2 If the Contractor or a Subcontractor recommends a particular product, material, system, or item of equipment for incorporation into the Project and the Owner accepts that recommendation, the above warranty includes a warranty from the Contractor to the Owner that the recommended product, material, system, or item of equipment is fit and appropriate for the associated purpose.

6.22 Additional Tests and Inspections

6.22.1 If before or after Substantial Completion the A/E or the Contracting Authority determines that any portion of the Work requires special inspection, testing, or approval not otherwise required under the Contract Documents, the A/E shall order such inspection, testing, or approval.

6.22.1.1 If the special inspection, testing, or approval reveals Defective Work, the Contractor shall pay all associated costs and will not be entitled to any related adjustment of the Contract Times. Those costs may include, but are not limited to:

- **.1** the cost of the special inspection, testing, or approval;
- **.2** the cost of conducting the special inspection, testing, or approval on similar Work regardless of whether the similar Work is also revealed as Defective Work;
- **.3** the cost of additional special inspections, testing, or approvals to evaluate remedial Work;
- **.4** the cost of correcting the Defective Work; and
- **.5** all related Owner-incurred fees and charges of contractors, engineers, architects, attorneys, and other professionals.

6.22.1.2 The Contracting Authority may deduct the costs described under **Section 6.22.1.1** from payments then or thereafter due the Contractor. If payments then or thereafter due the Contractor are not sufficient to cover those amounts, the Contractor shall immediately pay the amount of the insufficiency to the Owner.

6.22.1.3 If the special inspection, testing, or approval reveals that the Work complies with the Contract Documents, and the Contractor believes that it is entitled to an adjustment of the Contract Sum or Contract Times, or both, on account of the special inspection, testing, or approval, the Contractor shall initiate a Change Request **(1)** as required under **Section 7.6**, and **(2)** within the time period required under **Section 7.6** which begins to run on the day of the special inspection, testing, or approval.

6.22.2 If the Contractor is aware of a need for inspection, testing, or approval, or of a need to have any inspection, testing, or approval completed by a particular time to avoid delay, then the Contractor shall timely communicate such information to the A/E and Contracting Authority.

6.22.3 Except as described under **Section 6.22.1**, the Owner shall pay for any inspection, testing, or approval that did not become a requirement until after it awarded the Contract.

6.22.4 The Contractor shall coordinate with and give the A/E, Contracting Authority, and Owner reasonable notice of the anticipated dates of all inspections, testing, or approvals.

6.22.5 Within five days after completion of an inspection, testing, or approval, the A/E shall provide an original report/certificate of the inspection, testing, or approval to the Contractor and Contracting Authority with a recommendation for or against acceptance of the results therein.

6.23 Uncovering the Work

6.23.1 If the Contractor covers Work contrary to the requirements of the Contract Documents or contrary to the written request of the Contracting Authority or A/E, the Contractor shall, if the Contracting Authority or A/E requests in writing, uncover that Work for observation, correct it if not in conformity with the Contract Documents, and recover it at the Contractor's expense without adjustment of the Contract Times.

6.23.2 If the Contractor covers Work in accordance with the Contract Documents and not contrary to a request from the A/E or Contracting Authority for an opportunity to observe the Work prior to covering, the Contractor shall, if the A/E requests in writing, uncover that Work.

6.23.2.1 If the uncovered Work is Defective Work, the Contractor shall pay the costs of uncovering, correcting, and recovering the Work and shall not be entitled to an adjustment of the Contract Times.

6.23.2.2 If the uncovered Work is not Defective Work and the Contractor believes that it is entitled to an adjustment of the Contract Sum or Contract Times, or both, on account of the uncovering and recovering of the Work, the Contractor shall initiate a Change Request **(1)** as required under **Section 7.6**, and **(2)** within the time period required under **Section 7.6** which begins to run on the day that the Contracting Authority or A/E observes the uncovered Work.

6.24 Correction of the Work

6.24.1 Before Substantial Completion.

6.24.1.1 If the Contractor provides Defective Work or fails or neglects to perform the Work in accordance with the Construction Progress Schedule, the Contracting Authority or A/E may issue a written notice to the Contractor and Contractor's Surety directing the Contractor to correct the Defective Work or recover schedule deficiencies. Unless otherwise specified in that written notice, the Contractor shall promptly commence and diligently pursue correction of the Defective Work and recovery of schedule deficiencies within three days after the Contracting Authority issues the written notice ("72-Hour Notice").

6.24.1.2 If the Contractor fails to promptly commence and diligently pursue correction of the Defective Work and recovery of schedule deficiencies required under **Section 6.24.1.1**, the Owner may correct the Defective Work or take action to recover schedule deficiencies without giving further notice to the Contractor or Contractor's Surety.

6.24.2 After Substantial Completion.

6.24.2.1 In addition to the Contractor's other obligations under the Contract Documents, if any of the Work is found to be Defective Work after Substantial Completion, the Contractor shall correct it promptly after receipt of written notice from the A/E, Contracting Authority, or Owner to do so, unless the Contracting Authority and Owner have previously acknowledged and accepted the Defective Work in writing as described under **Section 6.25.1**. The A/E, Contracting Authority, or Owner may send a copy of the written notice to the Contractor's Surety, but are not obligated to do so.

6.24.2.2 During the Correction Period. If the Contracting Authority or Owner issues a notice under **Section 6.24.2.1** during the Correction Period, the Owner may correct the Defective Work itself without giving further notice to the Contractor or Contractor's Surety if the Contractor fails to **(1)** notify the Owner in writing of the Contractor's intent to correct the Defective Work within seven days after the Contracting Authority or Owner issues the notice and **(2)** thereafter promptly commence and diligently pursue correction of Defective Work.

6.24.2.3 The Correction Period:

.1 commences on the date of Substantial Completion of the Work or a designated portion of the Work which the Contracting Authority and Owner have agreed to take Partial Occupancy;

.2 relates only to the Contractor's specific obligation and opportunity to correct the Work during the Correction Period;

.3 does not establish a period of limitation with respect to any of the Contractor's other obligations under the Contract Documents;

.4 has no relationship to the time within which the State or Owner may seek to enforce the Contract;

.5 does not establish a period of limitation within respect to the commencement of litigation to establish the Contractor's liability under the Contract or otherwise; and

.6 shall not be extended by corrective Work performed by the Contractor under this **Section 6.24.2**.

6.24.2.4 After the Correction Period. If the Owner issues a notice under **Section 6.24.2.1** after expiration of the Correction Period, the Owner may correct the Defective Work without giving further notice to the Contractor or Contractor's Surety if the Contractor fails to **(1)** notify the Owner in writing of the Contractor's intent to correct the Defective Work within 14 days after the Owner issues the notice and **(2)** thereafter promptly commence and diligently pursue correction of Defective Work.

6.24.3 Emergency Correction of Defective Work.

6.24.3.1 Notwithstanding any other provision of the Contract to the contrary, if in the Contracting Authority's or Owner's opinion the Defective Work presents a threat of imminent harm or danger to people, property, or the environment, the Contracting Authority or Owner may order the Contractor to immediately correct Defective Work or the Owner may correct the Defective Work itself without any prior notice to the Contractor or Contractor's Surety.

6.24.4 Responsibility for Costs of Correction.

6.24.4.1 The Contractor shall pay all of the costs and damages associated with the correction of Defective Work and the recovery of schedule deficiencies under this **Section 6.24**. Those costs and damages may include, but are not limited to, the related fees and charges of contractors, engineers, architects, attorneys, and other professionals; and the cost of correcting or replacing adjacent work. The Contracting Authority may deduct those costs and damages from payments then or thereafter due the Contractor. If payments then or thereafter due the Contractor are not sufficient to cover those amounts, the Contractor shall immediately pay the amount of the insufficiency to the Owner.

6.25 Acceptance of Defective Work

6.25.1 Before final Contract Completion, the Owner may accept any Defective Work instead of requiring its removal or correction, in which case the Contract Sum shall be equitably reduced as described under **Article 7**.

6.25.1.1 The Owner may only accept Defective Work through a deduct Change Order that makes explicit reference to this **Section 6.25**.

6.25.1.2 After final Contract Completion, the Owner may only accept Defective Work by giving written notice to the Contractor that the Owner is accepting the associated Defective Work.

6.25.2 None of the following will constitute **(1)** acceptance of Defective Work, **(2)** a release of the Contractor's obligation to perform the Work in accordance with the Contract, or **(3)** a waiver of any rights set forth in the Contract or otherwise provided by Applicable Law:

6.25.2.1 observations or inspections by the Owner, Contracting Authority, or A/E;

6.25.2.2 the making of any payment;

6.25.2.3 Substantial Completion or the issuance of a Certificate of Substantial Completion;

6.25.2.4 Partial Occupancy and the Owner's use or occupancy of the Work or any part of it;

6.25.2.5 Contract Completion or the issuance of a partial or final Certificate of Contract Completion;

6.25.2.6 any review or approval of a submittal;

6.25.2.7 any inspection, test, or approval by other Persons; or

6.25.2.8 any correction of Defective Work by the Owner.

6.26 Project Document Maintenance and Submittal

6.26.1 During Construction.

6.26.1.1 The Contractor shall maintain in good order at a secure location on the Site:

.1 a complete copy of all Contract Documents; Shop Drawings, Product Data, Samples and similar required submittals; manufacturer operating and maintenance instructions; certificates; warranties; RFIs and responses thereto; and other Project-related documents, all marked currently and accurately to record field changes and selections made during construction and to show actual installation where installation varies from Work as originally shown, including the exact location and depth of underground utility lines; and

.2 a set of Drawings and Specifications, approved in accordance with **Section 5.2.1.1**, and the records required by **Section 6.2.14**.

6.26.1.2 Before submitting each Contractor Payment Request, the Contractor shall record all changes on the Contract Documents, neatly in a contrasting color, noting new information not shown on the original Contract Documents. Failure to record all changes may cause payment to be withheld or delayed by the Contracting Authority.

6.26.1.3 The Contractor shall keep a record of changes made to the Specifications, noting particularly any approved variation from manufacturers' installation instructions and recommendations.

6.26.1.4 If the Contractor uses Shop Drawings to indicate as-built conditions, the Contractor shall cross-reference the Shop Drawing sheet numbers to the corresponding sheet numbers on the Contract Documents. The Contractor shall note related numbers where applicable.

6.26.1.5 The Contractor shall at all times permit access to the documents described in this **Section 6.26.1** to authorized representatives of the State, local authorities with jurisdiction over the Project, Contracting Authority, Owner, and A/E.

6.26.2 Before Contract Completion.

6.26.2.1 As a condition precedent to execution of the Certificate of Contract Completion and final payment, the Contractor shall submit to the A/E:

.1 all LEED-related documents not previously submitted (if applicable); and

.2 the As-Built Documents including one electronic version and one hard-copy version organized into suitable sets of manageable size bound with durable cover sheets and appropriate identification marked on the front and the spine of each binder.

6.26.2.2 The Contractor's As-Built Documents submission shall include, but is not limited to:

.1 Certificate of Occupancy;

.2 inspection certificates for pressure piping, elevator, boiler, electrical, plumbing or piping purification, etc.;

.3 Letter of Approval from the local fire authority or State Fire Marshal for the fire suppression system;

.4 Operation and Maintenance Manuals;

.1 The Contractor shall organize the hard copy of the Operation and Maintenance Manuals into suitable sets of manageable size, and include indexed data bound in individual binders, with pocket folders for folded sheet information.

.5 neatly and accurately marked sets of As-Built Documents, and other Contract Documents reflecting the actual construction of the Project;

.6 detailed Drawings reflecting the exact location of any concealed utilities, mechanical or electrical systems, and components;

.7 assignment to the Owner of all warranties and guarantees, including the most-recent address and telephone number of any Subcontractors or manufacturers.

6.26.2.3 By submitting the As-Built Documents to the A/E, the Contractor certifies that its As-Built Documents are complete, correct, and accurate.

6.26.3 Record Documents.

6.26.3.1 The A/E shall revise the original Contract Documents and related Electronic Files with the information contained on the As-Built Documents. The A/E shall label the revised original Contract Documents and related Electronic Files as "Record Documents" and reflect the date of the A/E's incorporation of the As-Built Documents.

6.26.3.2 The Owner may thereafter use the Record Documents for any purpose relating to the Project including, but not limited to, additions to or completion of the Project.

6.27 Final Cleaning

6.27.1 Before requesting the Substantial Completion inspection of the Work, the Contractor shall clean the Site, remove waste materials and rubbish attributable to the Project, and restore the property to its original condition so that upon Substantial Completion, the premises are ready for occupancy by the Owner.

6.27.2 If the Contractor performs any Work after final cleaning, the Contractor shall clean the affected area as provided above so that upon Substantial Completion, the premises are ready for occupancy by the Owner.

6.27.3 Final cleaning shall be done to the reasonable satisfaction of the A/E and Contracting Authority.

6.28 Substantial Completion

6.28.1 Contractor's Punch List.

6.28.1.1 When the Contractor considers the Work, or a designated portion thereof, Substantially Complete the Contractor shall inspect the Work and prepare a list of Defective Work and incomplete or unacceptable Work ("Contractor's Punch List"). The Contractor shall list all items of Work not in compliance with the Contract Documents, including items the Contractor is requesting to be deferred.

.1 The Contractor shall proceed to correct all items listed on the Contractor's Punch List and certify that the incomplete items listed on the Contractor's Punch List are to its knowledge an accurate and complete list by signing the Contractor's Punch List.

.2 The Contractor's failure to include an item on the Contractor's Punch List shall not alter the Contractor's responsibility to complete the Work in accordance with the Contract Documents.

.3 The Contractor shall submit the signed Contractor's Punch List to the A/E, together with a request for the Substantial Completion inspection of the Work.

6.28.2 Substantial Completion Inspection.

6.28.2.1 Within three business days after receipt of the request for the Substantial Completion inspection of the Work, the A/E shall notify the Contractor of acceptance or rejection of the request, stating reasons for any rejection.

.1 Within seven days after its acceptance of the Contractor's request, the A/E shall conduct the Substantial Completion inspection to determine whether the Work, or designated portion, is in conformity with the Contract Documents and Substantially Complete. The A/E shall notify the Contractor, Contracting Authority, and Owner of the scheduled time of the inspection.

.2 If the A/E determines that the Work is Substantially Complete, within three business days after the Substantial Completion inspection, the A/E shall prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion and include a list of Defective, incomplete, or unacceptable Work ("A/E's Punch List"). The A/E's Punch List shall include **(1)** the items on the Contractor's Punch List that are not yet completed or corrected as of the date of the Substantial Completion inspection, and **(2)** comments from the Contracting Authority and Owner.

.3 The A/E shall submit the Certificate of Substantial Completion to the Contracting Authority, Owner, and Contractor for their written acceptance. Upon their acceptance and consent of the Contractor's Surety, and subject to the Owner's right to withhold payment, the Owner shall release retainage as described under **Section 9.6.1**.

.4 The A/E's failure to include an item on the A/E's Punch List shall not alter the Contractor's responsibility to complete the Work in accordance with the Contract Documents.

.5 If the A/E accepts the request for the Substantial Completion inspection and subsequently determines that the Work is not Substantially Complete, the A/E may request compensation for expenses related to excessive Punch List activities. The Contracting Authority may deduct that additional compensation to the A/E from payments then or thereafter due the Contractor. If payments then or thereafter due the Contractor are not sufficient to cover those amounts, the Contractor shall immediately pay the amount of the insufficiency to the Owner.

6.28.3 Completion of Punch List Items.

6.28.3.1 Before expiration of the Punch List Milestone and before the date of Final Contract Completion, the Contractor shall complete all items on the A/E's Punch List. After completing all items on the A/E's Punch List, the Contractor shall provide a written request for Final Inspection of the Work to the A/E.

.1 If Work on the A/E's Punch List cannot be timely completed, the Contractor shall justify in writing to the reasonable satisfaction of the Contracting Authority and A/E, the reasons the items cannot be completed, and the Contractor may propose, for the Contracting Authority and A/E's approval, an adjustment of the

Punch List Milestone for the associated Punch List items to establish a time when the Contractor shall complete those items.

.2 Within three business days after receipt of the Contractor's request for the Final Inspection, the A/E shall complete a Final Inspection of the Work for compliance with the Contract Documents.

.3 If multiple inspections of items on the A/E's Punch List are required due to the Contractor's failure to properly and timely complete them, the Contractor shall pay any additional costs incurred by the A/E, Owner, and Contracting Authority resulting from any attendant delay and re-inspections. The Contracting Authority may deduct those additional costs from payments then or thereafter due the Contractor. If payments then or thereafter due the Contractor are not sufficient to cover those amounts, the Contractor shall immediately pay the amount of the insufficiency to the Owner.

6.29 Partial Occupancy

6.29.1 The Owner may occupy or use a portion of the Project prior to Substantial Completion of all Work if:

6.29.1.1 the building authority with jurisdiction over the Project issues a partial certificate of occupancy for the portion of the Project the Owner intends to occupy (if applicable);

6.29.1.2 the Owner with the Contractor's and A/E's assistance has provided written notice of the Partial Occupancy to the insurers providing builder's risk property insurance for the Project; and

6.29.1.3 the Contracting Authority has received notice of the Partial Occupancy from the A/E and has consented to it.

6.29.2 Before the Owner commences Partial Occupancy, the Owner, Contracting Authority, A/E, and Contractor shall proceed as described under **Section 6.28** for the area designated for Partial Occupancy. The Owner may commence Partial Occupancy before the Contractor has achieved Substantial Completion of the area designated for Partial Occupancy.

6.29.3 The Contractor shall be relieved of the obligation to maintain the area accepted for Partial Occupancy, but shall remain obligated to complete and correct the Work and to carry the insurance required by the Contract Documents during performance of any such Work.

6.30 Demonstration and Training, Operating Appurtenances

6.30.1 The Contractor, as a condition precedent to execution of the Certificate of Contract Completion and final payment, shall perform demonstration and training of the Owner's maintenance personnel as specified in the Contract Documents.

6.30.2 The Contractor, as a condition precedent to execution of the Certificate of Contract Completion and final payment, shall organize and submit operating appurtenances and loose items related to operation and maintenance of the completed Project to the Owner, including, but not limited to:

6.30.2.1 keys to door and window hardware, panels, and other devices not directly provided to the Owner from the manufacturer;

6.30.2.2 operating handles, levers, cranks, specialized wrenches or drivers, remote controls, and similar items; and

6.30.2.3 extra materials (e.g., attic stock).

6.31 Contract Completion

6.31.1 Partial Contract Completion.

6.31.1.1 When items of Work cannot be completed until a subsequent date, the A/E shall prepare a partial Certificate of Contract Completion that shall include a detailed list of the deferred Work and the date(s) by which the Contractor will complete that Work.

6.31.1.2 The A/E shall submit the partial Certificate of Contract Completion to the Contracting Authority, Owner, and Contractor for their written acceptance. After they accept the partial Certificate of Contract Completion and the Contractor has submitted the Contractor's Surety's consent to payment, the Contracting Authority may release payment to the Contractor in the Contracting Authority's sole discretion.

6.31.2 Final Contract Completion.

6.31.2.1 When all items on the A/E's Punch List have been completed to the satisfaction of the A/E, all requirements of the Contract Documents have been completed, and the provisions of **Sections 6.26** through **6.30** have been fulfilled, the A/E shall prepare and recommend execution of a final Certificate of Contract Completion.

The date that the Contracting Authority executes the final Certificate of Contract Completion is the date of Contract Completion.

6.31.2.2 Within 30 days after the Contracting Authority executes the final Certificate of Contract Completion, the Contracting Authority will make final payment to the Contractor of all remaining funds then due and payable including any funds retained following Substantial Completion as described under **Section 9.7**.

ARTICLE 7 - MODIFICATIONS

7.1 General

7.1.1 Changes in the Work.

7.1.1.1 The Contracting Authority may order changes in the Work without invalidating the Contract. Subject to the limitations stated in this **Article 7** and elsewhere in the Contract Documents, a change in the Work may be accomplished by a Change Order, Change Directive, or order for a minor change in the Work.

- **.1** The Contractor shall proportionately increase the amount of the Bond whenever the Contract Sum is increased.
- **.2** If notice of any change affecting the Contract is required by the provision of any Bond, notice is the Contractor's responsibility, and the amount of each applicable Bond shall be adjusted accordingly.

7.1.1.2 The Contractor shall not proceed with any change in the Work without the Contracting Authority's prior written authorization except as provided under **Sections 1.10** and **7.4**.

7.1.1.3 Except as provided in **Section 1.10**, the Contractor's failure to obtain prior written authorization for a change in the Work will prejudice the Owner and Contracting Authority and constitute a waiver by the Contractor of any adjustment to the Contract Sum or Contract Times, or both, for the related Work.

7.1.1.4 The Contractor shall perform all changes in the Work under the applicable provisions of the Contract Documents, and the Contractor shall proceed promptly with the change unless otherwise provided in the Change Order, Change Directive, or order for a minor change in the Work

7.1.2 Paperwork Consolidation.

7.1.2.1 Related Modifications, with the same or similar justification (e.g., Owner Request or field resolution), may be consolidated into the same Change Order.

7.1.2.2 Add and deduct Modifications, with the same or similar justification, may be included on the same Change Order.

7.1.2.3 Modifications resulting from errors or omissions shall not be combined with other modifications for which the A/E will receive a fee.

7.1.3 Modification Numbering.

7.1.3.1 The A/E shall assign a number to each Modification, which shall uniquely identify it.

7.1.3.2 The A/E shall not duplicate or reuse any number throughout the Project or reuse assigned numbers for Proposal Requests that are initiated but cancelled in process.

7.1.3.3 The number for each Change Order shall be coordinated with any associated Proposal Request, Change Request, or Change Directive.

7.1.4 Modification Log.

7.1.4.1 The A/E shall create and maintain a Modification Log for the Project, which shall contain the following minimum information:

- **.1** number of the Modification;
- **.2** a brief description of the Modification;
- **.3** cost of the Modification;
- **.4** schedule impact of the Modification; and
- **.5** dates sent to, and received from, the parties.

7.1.5 Reconciliation of Unit Price Items.

7.1.5.1 The Contracting Authority may increase, decrease, or delete entirely the scheduled quantities of Unit Price Work.

7.1.5.2 If the actual quantity of a Unit Price item exceeds or appears that it will exceed the scheduled quantity, the Contractor shall immediately notify the A/E in writing. The A/E, after consulting with the Contracting Authority, will issue a Change Order or Change Directive to authorize an adjustment of the scheduled quantity or to otherwise address the excess.

7.1.5.3 If the actual quantity of a Unit Price item differs from the scheduled quantity by 20 percent or more, so that application of the Unit Price to the quantities of Work performed or reasonably expected to be performed would create an undue hardship on either the Owner or Contractor:

.1 the Contractor shall initiate a Change Request seeking an adjustment of the Unit Price **(1)** as required under **Section 7.6**, and **(2)** within the time period required under **Section 7.6** which begins to run on the day that the Contractor knew or should have known that the actual quantity of a Unit Price item would differ from the scheduled quantity by 20 percent or more; or

.2 the A/E, after consulting with the Contracting Authority, will issue a Change Directive to adjust the Unit Price.

7.1.5.4 If a Unit Price is adjusted as described under **Section 7.1.5.3**, the new Unit Price will only apply to the units of Work performed that are **(1)** less than the 20 percent threshold if the Unit Price is changed on account of an over-estimation of the scheduled quantity of a Unit Price item involved in the Work or **(2)** in excess of the 20 percent threshold if the Unit Price is changed on account of an under-estimation of the scheduled quantity of a Unit Price item involved in the Work.

7.1.5.5 Before final payment, the A/E shall issue a Change Order to reconcile any difference between the scheduled and actual quantities of Unit Price Work performed and materials furnished.

7.1.5.6 Notwithstanding **Section 7.1.5.3**, if the actual quantity of any item of Unit Price Work is zero, there shall be no adjustment of the Unit Price.

7.1.6 Notice of Credits and Schedule Reductions.

7.1.6.1 Notwithstanding any other provision of the Contract to the contrary, the Contractor shall promptly notify the Contracting Authority, Owner, and A/E in writing whenever any change in the Project (including without limitation through an order for a minor change in the Work) may entitle the Owner to a credit from the Contractor or a reduction of the time for completion of the Project.

7.2 Change Orders

7.2.1 A Change Order is a written instrument prepared by the A/E and executed by the Contracting Authority, Owner, and Contractor, stating their agreement upon all of the following:

7.2.1.1 a change in the Work;

7.2.1.2 the amount of the adjustment of the Contract Sum, if any; and

7.2.1.3 the extent of the adjustment of the Contract Times, if any.

7.2.2 Except with the Contracting Authority's written consent as explicitly provided under **Sections 7.3.9**, **7.3.10**, **7.6.2**, and **7.6.3**, the Contractor is not entitled to reserve any rights or take other similar action with respect to a Change Order if the effect or intent of the reservation or action would be to accommodate a further adjustment of the Contract Sum or Contract Times, or both, after the Contractor signs the Change Order. By signing a Change Order, the Contractor irrevocably certifies that the elements of a Change Order described in **Section 7.2.1** are completely and fully satisfied, and waives all rights, if any, to seek further adjustment of the Contract Sum or Contract Times, or both, at a later date with respect to the associated change in the Work including without limitation on account of **(1)** the "cumulative impact" of the associated change in the Work in combination with one or more other changes in the Work; **(2)** all costs, including interest on those costs; and **(3)** any delays, inefficiencies, disruptions, suspensions, extended overhead, and acceleration.

7.2.3 The A/E shall prepare each Change Order form, attach the supporting documentation, and issue the Change Order to the Contractor for signature.

7.2.4 If the Contractor is in agreement with the Change Order under **Section 7.2.1**, the Contractor shall sign and return the Change Order to the A/E within three days after receiving it.

7.2.5 When the A/E receives the Change Order signed by the Contractor, the A/E will recommend approval by signing the form and transmitting the Change Order and the revised Change Order Log to the Owner.

7.2.6 When the Owner receives the Change Order, the Owner may sign the form accepting the Change Order, attach certification of funding, and transmit the Change Order to the Contracting Authority; or, if the Owner does not accept the Change Order, the Owner will reject and return it to the A/E.

7.2.7 When the Contracting Authority receives the Change Order, the Contracting Authority may sign the form approving the Change Order, and transmit the fully executed Change Order to all signers; or, if the Contracting Authority does not accept the Change Order, the Contracting Authority will reject and return it to the A/E.

7.2.8 When the Change Order is signed by the Contractor, A/E, Owner, and Contracting Authority, the fully executed Change Order modifies the Contract Documents and authorizes and directs the Contractor to proceed, and the Contractor shall promptly proceed with the associated change in the Work.

7.3 Change Directives

7.3.1 A Change Directive is a written order prepared by the A/E and executed by the Contracting Authority and Owner directing a change in the Work or the performance of disputed Work as described under **Section 7.3.4.1**.

7.3.1.1 The parties will endeavor to resolve each Change Directive through the Field Meeting described under **Section 7.7**.

7.3.2 Through a Change Directive, the Contracting Authority may:

7.3.2.1 propose a basis for adjustment, if any, in the Contract Sum or Contract Times, or both; or

7.3.2.2 limit the scope of the change in the Work on a time and materials basis, not to exceed a fixed adjustment of the Contract Sum.

7.3.3 If a change in the Work must start immediately to avoid an imminent impact to the schedule of the Project, the A/E may prepare a Change Directive for the Contracting Authority's and the Owner's signatures pursuant to **Section 7.3.1**, authorizing the Contractor to proceed.

7.3.4 A Change Directive shall be used to direct a change in the Work in the absence of total agreement on the terms of a Change Order.

7.3.4.1 For the purposes of clarity, the Contract refers to a Change Directive as if it is only to be used in the absence of total agreement on the terms of a Change Order concerning the associated change of the Work. A Change Directive may also be used in the absence of agreement as to whether the subject of the Change Directive actually constitutes a change in the Work; such as but not limited to the situations described under **Sections 6.9.2** and **7.4.3**.

7.3.5 Upon receipt of a Change Directive, the Contractor shall promptly proceed with the change in the Work involved.

7.3.6 If the Change Directive contains a proposed basis for adjustment of the Contract Sum or Contract Times, or both, within ten days after receiving it, the Contractor may sign the Change Directive to accept the proposed basis for adjustment, and return it to the A/E. Thereafter, the A/E shall prepare and the A/E, Contracting Authority, Owner, and Contractor shall promptly execute an associated Change Order as described under **Section 7.2**.

7.3.7 Within ten days after receiving the Change Directive, or other period as mutually agreed by the Contractor and Contracting Authority, the Contractor shall submit to the A/E and Contracting Authority a Proposal meeting the requirements of **Section 7.5** for adjustment of the Contract Sum or Contract Times, or both, on account of the change, unless the Change Directive is performed on a time and materials basis under **Section 7.3.2.2**. If the Change Directive is performed on a time and materials basis, the Contractor shall submit its Proposal within ten days after completing the changed Work, which is the subject of the Change Directive.

7.3.8 If the Contractor does not respond to a Change Directive as and when required under **Section 7.3.6** or **Section 7.3.7 (1)** the Contracting Authority shall determine the adjustments, if any, of the Contract Sum and Contract Times and issue its determination to the Owner, A/E, and Contractor, and **(2)** the A/E shall prepare a Change Order consistent with that determination and issue it to the Contractor as described under **Section 7.2.3**. If the Contractor does not agree with the Contracting Authority's determination, the Contractor shall initiate a Claim as and when required under **Article 8**.

7.3.9 Pending final determination of the total adjustment of the Contract Times on account of a Change Directive, to the extent that the Contracting Authority, Owner, and Contractor agree on a portion of the adjustment of the Contract Times, that the period of time not in dispute may be included in the Construction Progress Schedule accompanied by a Change Order indicating the parties' agreement with only that portion of the time adjustment.

7.3.10 Pending final determination of the total adjustment of the Contract Sum on account of a Change Directive, to the extent that the Contracting Authority, Owner, and Contractor agree on a portion of the adjustment of the Contract Sum, the amount not in dispute for that change in the Work may be included in a Contractor Payment Request accompanied by a Change Order indicating the parties' agreement with only that portion of the cost adjustment.

7.3.11 If the Contracting Authority, Owner, and Contractor agree on the adjustments of the Contract Sum and Contract Times associated with a Change Directive, the A/E shall prepare an appropriate Change Order. The A/E, Contracting Authority, Owner, and Contractor shall sign the Change Order as described under **Section 7.2**.

7.3.12 If the Contracting Authority, Owner, and Contractor do not agree on the adjustments of the Contract Sum and Contract Times associated with a Change Directive, **(1)** the Contracting Authority shall determine the adjustments, if any, of the Contract Sum and Contract Times and issue its determination to the Owner, A/E, and Contractor, and **(2)** the A/E shall prepare a Change Order consistent with that determination and issue it to the Contractor as described under **Section 7.2.3**. If the Contractor does not agree with the Contracting Authority's determination, the Contractor shall initiate a Claim as and when required under **Article 8.**

7.3.13 The Contracting Authority may at any time reject the Contractor's Proposal submitted under **Section 7.3.7**. If the Contractor does not agree with the Contracting Authority's rejection, the Contractor shall initiate a Claim as and when required under **Article 8**.

7.3.14 If a Change Directive or portion of a Change Directive remains pending or otherwise unresolved 60 days after the date on which the Change Directive was issued, the associated Contractor's Proposal or portion of the Contractor's Proposal still pending will be deemed rejected by the Contracting Authority. If the Contractor does not agree with the deemed rejection, the Contractor shall initiate a Claim as and when required under **Article 8**.

7.3.15 The Contractor's failure to comply with the requirements of this **Section 7.3** will constitute an irrevocable waiver of the Contractor's Proposal and any related Claim.

7.4 Minor Changes in the Work

7.4.1 The A/E may order minor changes in the Work not involving adjustment of the Contract Sum or extension of the Contract Times and not inconsistent with the intent of the Contract Documents. Those changes shall be effected by written order issued to the Contractor.

7.4.2 The Contractor shall promptly carry out each order for a minor change in the Work if the Contractor agrees that the order does not involve adjustment of the Contract Sum or Contract Times, or both.

7.4.3 If the Contractor reasonably believes that it would be entitled to an adjustment of the Contract Sum or Contract Times, or both, on account of an order for a minor change in the Work, the Contractor, within five business days after receiving the order, shall give the Contracting Authority and A/E written notice of the Contractor's position, and not proceed with the subject Work without first receiving a Change Directive or Change Order related to it.

7.4.4 The Contractor waives its right to an adjustment of the Contract Sum or Contract Times on account of an order for a minor change in the Work by:

7.4.4.1 starting the Work that is the subject of the order for a minor change in the Work; or

7.4.4.2 failing to give the notice described under **Section 7.4.3** within five business days after receiving the order for a minor change in the Work.

7.5 Proposal Requests and Contractor Proposals

7.5.1 Proposal Requests. The A/E shall prepare and issue a Proposal Request to the Contractor to obtain the Contractor's Proposal for the adjustment of the Contract Sum or Contract Times, or both, associated with a contemplated change in the Work.

7.5.1.1 The Contractor shall respond with a Proposal to the A/E and Contracting Authority within ten days after receiving the Proposal Request. The allowable time for the Contractor's response may be extended by written agreement of the Contractor and A/E.

7.5.1.2 If the Contractor does not submit a Proposal within the time required in **Section 7.5.1.1**, the Contractor waives its right to an adjustment of the Contract Sum or Contract Times, or both, associated with the contemplated change in the Work.

7.5.1.3 A Proposal Request does not authorize the Contractor to proceed with a change in the Work.

7.5.2 Contractor Proposals in General.

7.5.2.1 In any Proposal for an adjustment of the Contract Sum, the Contractor shall specifically identify the items set forth in **Section 7.8**. By submitting a Proposal for an adjustment of the Contract Sum, the Contractor represents to the Contracting Authority and Owner that the proposed adjustment is the entire adjustment of the Contract Sum to which the Contractor is entitled on account of the associated change or proposed change in the Work.

7.5.2.2 In any Proposal for an adjustment of the Contract Times, the Contractor shall specifically identify the items set forth in **Section 7.9**. By submitting a Proposal for an adjustment of the Contract Times, the Contractor represents to the Contracting Authority and Owner that the proposed adjustment is the entire adjustment of the Contract Times to which the Contractor is entitled on account of the associated change or proposed change in the Work.

7.5.2.3 The Contractor shall hold every Proposal valid and open for acceptance for at least 45 days. The acceptance period may be adjusted by mutual consent of the Contractor and Contracting Authority.

7.5.2.4 A Proposal may be accepted by the Contracting Authority and Owner only through a Change Order.

7.5.2.5 The Contractor's cost of preparing and providing Proposals is included in the Contract Sum and shall not be included in any cost or credit determination under the Contract.

7.5.3 Contractor Proposals Related to Change Requests. In addition to complying with **Section 7.5.2**, if the Proposal relates to a Change Request, the Contractor shall include in the Proposal the following information to permit timely and appropriate evaluation of the Change Request, determination of responsibility, and opportunity for mitigation:

7.5.3.1 if applicable, the Contractor's planned actions to mitigate costs and delays by avoiding interference, disruption, hindrance, delay, or impact;

7.5.3.2 recommended action to mitigate costs and delays by avoiding interference, disruption, hindrance, delay, or impact; and

7.5.3.3 additional information **(1)** the Contracting Authority requests or **(2)** the Contractor believes is relevant to resolution of the Change Request.

7.6 Change Requests

7.6.1 The Contractor shall initiate a change in the Work by submitting to the Contracting Authority and A/E a Change Request accompanied by a Proposal meeting the requirements of **Section 7.5** within ten days after the occurrence of the event giving rise to the Change Request.

7.6.1.1 The parties will endeavor to resolve each Change Request through the Field Meeting described under **Section 7.7**.

7.6.2 Pending final determination of the total adjustment of the Contract Times on account of a Change Request, to the extent that the Contracting Authority, Owner, and Contractor agree on a portion of the adjustment of the Contract Times, that period of time not in dispute may be included in the Construction Progress Schedule accompanied by a Change Order indicating the parties' agreement with only that portion of the time adjustment.

7.6.3 Pending final determination of the total adjustment of the Contract Sum on account of a Change Request, to the extent that the Contracting Authority, Owner, and Contractor agree on a portion of the adjustment of the Contract Sum, the amount not in dispute for that change in the Work may be included in a Contractor Payment Request accompanied by a Change Order indicating the parties' agreement with only that portion of the cost adjustments.

7.6.4 If the Contracting Authority, Owner, and Contractor agree on the adjustments of the Contract Sum and Contract Times associated with a Change Request, the A/E shall prepare an appropriate Change Order. The A/E, Contracting Authority, Owner, and Contractor shall sign the Change Order as described under **Section 7.2**.

7.6.5 If the Contracting Authority, Owner, and Contractor do not agree on the adjustments of the Contract Sum and Contract Times associated with a Change Request, **(1)** the Contracting Authority may determine the adjustments, if any, of the Contract Sum and Contract Times and issue its determination to the Owner, A/E, and Contractor, and **(2)** the A/E shall prepare a Change Order consistent with that determination and issue it to the Contractor as described under **Section 7.2.3**. If the Contractor does not agree with the Contracting Authority's determination, the Contractor shall initiate a Claim as and when required under **Article 8**.

7.6.6 The Contracting Authority may at any time reject the Contractor's Change Request and Proposal submitted under **Section 7.6.1**. If the Contractor does not agree with the Contracting Authority's rejection, the Contractor shall initiate a Claim as and when required under **Article 8**.

7.6.7 If a Change Request or portion of a Change Request remains pending or otherwise unresolved 60 days after the date on which the Change Request was submitted, the Change Request or portion of the Change Request still pending will be deemed rejected by the Contracting Authority. If the Contractor does not agree with the deemed rejection, the Contractor shall initiate a Claim as and when required under **Article 8**.

7.6.8 The Contractor's failure to comply with the requirements of this **Section 7.6** will constitute an irrevocable waiver of the Change Request and any related Claim.

7.7 Field Meeting

7.7.1 The Contracting Authority, Owner, and Contractor shall meet to review and endeavor to resolve **(1)** a Change Directive within 14 days after the Contracting Authority and Owner issue it under **Section 7.3.1** and **(2)** a Change Request within seven days after the Contractor initiates it under **Section 7.6.1**.

7.7.2 Notwithstanding **Section 7.7.1**:

7.7.2.1 a Field Meeting is not a condition precedent to the exercise of any right or the performance of any obligation under the Contract;

7.7.2.2 whether and when a Field Meeting is convened does not alter any right or any obligation under the Contract; and

7.7.2.3 the Contracting Authority, Owner, and Contractor may convene a Field Meeting at any time to address and attempt to resolve any pending Change Directive, Change Request, or other matter.

7.8 Change Order Cost or Credit Determination

7.8.1 General.

7.8.1.1 The maximum cost or credit resulting from a change in the Work shall be determined as described below.

.1 Proposals shall include the information required by **Section 7.8.1.4**.

.2 A Unit Price Proposal shall only be valid when incorporated into the Contract by Change Order except for Unit Price Work included in the Contract.

.3 The maximum cost or credit includes all compensation for impact costs. Additional costs for impacts shall not be allowed.

7.8.1.2 The Contractor shall not assign any portion of the Work to another Person whereby the Contractor would benefit directly or indirectly from the double application of charges for overhead or profit.

Example: Assume that **(1)** the Contractor is or is capable of self-performing general trades Work and **(2)** the change in the Work includes both electrical trade Work and general trades Work. The Contractor may not assign the general trades Work to the Contractor's electrical Subcontractor and then perform that general trades Work as a sub-subcontractor to the Contractor's electrical Subcontractor.

7.8.1.3 The Contracting Authority may require notarized invoices for material costs and may audit the records of the Contractor and Subcontractors.

7.8.1.4 For each change in the Work, the Contractor shall furnish a detailed Proposal itemized on the **Proposal Worksheet Summary Form (Contractor)** published by the Ohio Facilities Construction Commission through which the Contractor shall document the related changes in the Contract Sum as described under **Section 7.8.2**. Any Subcontractor pricing shall be itemized on the appropriate **Proposal Worksheet Summary Form**.

.1 The Contractor's cost of preparing and providing Proposals is included in the Contract Sum and shall not be included in any cost or credit determination under the Contract.

7.8.1.5 Section 7.8.2 establishes the exclusive and maximum amount that the Owner shall pay for any change in the Work, including, but not limited to, all amounts for interference with, delay, hindrance, disruption of, or impact on the Work ("Pricing Criteria"). These Pricing Criteria also govern the value of deduct Change Orders and the Contractor's entitlement to additional compensation or damages through the Change Directive, Change Request, Claims, and dispute resolution processes on account of changes in the Work. In order to expedite the review and approval process, Proposals shall be prepared in the categories and order listed in **Section 7.8.2**.

7.8.2 Pricing Criteria.

7.8.2.1 Contractor Personnel Costs. Any cost or credit arising from a change in the quantity of the Contractor's on-Site management (including supervision and administrative personnel) not subject to prevailing wage under ORC Chapter 4115 shall be calculated on an hourly basis according to the rates acceptable to the Contracting Authority.

.1 In no event will the Contractor be entitled to an increase in the Contract Sum on account of Contractor Personnel Costs unless the Contractor actually incurs additional Contractor Personnel Costs solely on account of the associated change in the Work.

.2 Under no conditions will the increase under this **Section 7.8.2.1** exceed those additional Contractor Personnel Costs the Contractor actually incurs.

7.8.2.2 Labor. Any cost or credit arising from a change in the quantity of field labor directly involved in the Work shall be based upon the actual rate of pay to the worker. If the Project is subject to payment of prevailing wage rates, field labor shall be paid according to the relevant classification of labor as established in the applicable prevailing wage determination for the Project locality, as determined by the Ohio Department of Commerce, Wage and Hour Bureau.

.1 In no event will the Contractor be entitled to an increase in the Contract Sum on account of labor costs unless the Contractor actually incurs additional labor costs solely on account of the associated change in the Work.

.2 Under no conditions will the increase under this **Section 7.8.2.2** exceed those additional labor costs the Contractor actually incurs.

.3 The cost for supervision above the level of working forepersons (such as general forepersons, superintendent, project manager, etc.) is included in the adjustment under **Section 7.8.2.1** for the Contractor and under **Section 7.8.2.10** for Subcontractors.

7.8.2.3 Fringes. Fringe benefit credit for labor provided under **Section 7.8.2.2** is only allowable for prevailing wage fringe benefits pursuant to ORC Chapter 4115, including, but not limited to, Health and Welfare, vacation, apprenticeship training, and certain types of pension plans. The parties shall defer to the Ohio Department of Commerce's policy on which benefits are granted fringe benefit credit. Each fringe benefit for which credit is requested shall be calculated on an hourly basis and listed as a separate line item. The Contractor shall submit documentation supporting the calculation of the amounts for each fringe benefit for each worker classification, including labor provided by Subcontractors.

7.8.2.4 Allowable Payroll Expenses. Allowable payroll expenses for labor provided under **Section 7.8.2.2** including payroll taxes as well as other benefits that are required by Applicable Law, such as federal and state unemployment and workers' compensation shall each be a separate line item and shall not be credited for compliance with ORC Chapter 4115.

7.8.2.5 Equipment Rentals. Any cost or credit arising from a change in the quantity of non-owned heavy or specialized equipment shall be based on the documented rental cost, but shall not exceed 100 percent of that documented cost. No rental charges shall be allowed for hand tools, minor equipment, simple scaffolds, etc. Downtime due to repairs, maintenance, and weather delays shall not be allowed. The Contractor shall submit copies of actual paid invoices to substantiate rental costs.

7.8.2.6 Owned Equipment. Any cost or credit arising from a change in the quantity of heavy or specialized equipment owned by the Contractor or Subcontractor performing the Work shall be based on the cost listed by the current edition of the Associated Equipment Distributors' *AED Blue Book* heavy equipment rental rates, but shall not exceed 100 percent of that documented cost. No recovery shall be allowed for hand tools, minor equipment, simple scaffolds, etc. The longest period of time that the equipment is to be required for the Work shall be the basis for the pricing. Downtime due to repairs, maintenance, and weather delays shall not be allowed.

7.8.2.7 Trucking. Any cost or credit arising from a change in the quantity of trucking shall be based on a reasonable delivery charge or per-mile trucking charge for delivery of required materials or equipment. Charges for use of a pick-up truck shall not be allowed.

7.8.2.8 Materials. Any cost or credit arising from a change in the quantity of materials incorporated into the changed Work shall be based on the actual cost (including all discounts, rebates, or related credits) of those materials. Documentation shall show costs, quantities, or Unit Prices of all items, as appropriate.

.1 The cost or credit for reusable materials (e.g., concrete form lumber, shoring, or temporary enclosures) shall be limited to 33 percent of the material cost for each use.

7.8.2.9 Contractor's General Conditions Costs. Any cost or credit arising from a change in the quantity of the Contractor's General Conditions Costs shall be limited to the extent to which the change is attributable to an associated change in the Contract Time for achievement of Substantial Completion resulting from the change in the Work.

.1 In no event shall the Contract Sum adjustment per day of Contract Time adjustment exceed an amount equal to **(1)** the sum of the General Conditions Costs line items in the Contractor's Schedule of Values approved by the Contracting Authority, **(2)** divided by the total number of days of the original Contract Time for achievement of Substantial Completion.

.2 The Contractor shall **(1)** exclude the Bond premium from the Schedule of Values for the purposes of the calculation under **Section 7.8.2.9.1**, and **(2)** include the actual adjustment of the Bond premium attributable to an associated change in the Contract Sum.

.3 If the Contractor purchases the builder's risk insurance for the Project, the Contractor shall **(1)** exclude the builder's risk insurance premium from the Schedule of Values for the purposes of the calculation under **Section 7.8.2.9.1**, and **(2)** include the actual adjustment of the builder's risk insurance premium attributable to an associated change in the Contract Sum.

7.8.2.10 Subcontractor Overhead and Profit. Any cost or credit arising from a change in Subcontractor-performed Work shall include the Subcontractor's aggregate overhead and profit allowance equal to 15 percent of the sum of the Subcontractor's costs described under **Sections 7.8.2.2** through **7.8.2.8** that are associated with that changed Work.

.1 The allowance applies to each Subcontractor tier. The Contractor is not entitled to recover overhead and profit under **Section 7.8.2.10** on account of changes in Contractor self-performed Work or Work the Contractor performs as a Subcontractor at any tier.

Example: Assume that **(1)** the Contractor is self-performing general trades Work and **(2)** the change in the Work includes both $25,000 of electrical trade Work and $10,000 of general trades Work. Under this **Section 7.8.2.10**, **(1)** the Contractor's Subcontractor would be entitled to overhead and profit mark-up but **(2)** the Contractor would not be entitled to any mark-up. Under **Section 7.8.2.11**, the Contractor would be entitled to Contractor's Fee mark-up on its self-performed Work and on the electrical Work. The amount of the Change Order would be calculated as follows: Subcontractor Change Order = $25,000 + ($25,000 x 15%) = $28,750; Contractor Change Order = $10,000 + $28,750 + (($10,000 + $28,750) x 10%) = $42,625.

.2 The allowance covers Subcontractor general conditions costs, home office overhead, and profit including, but not limited to: payroll costs, the costs required to schedule and coordinate the Work, telephone, telephone charges, facsimile, telegrams, postage, photos, photocopying, hand tools, simple scaffolds (one level high), tool breakage, tool repairs, tool replacement, tool blades, tool bits, home office estimating and expediting, home office clerical and accounting support, home office labor (management, supervision, engineering), all costs related to Subcontractor-provided insurance, all other home office expense, legal services, travel, and parking expenses.

.3 An exception is allowed for shop or engineering labor on items in **Section 7.8.2.10.2**, which shall not be subject to Prevailing Wage rates for steel fabricators, sheet metal fabricators, and sprinkler system fabricators performing work off Site. Recovery for these matters shall be allowed on an hourly basis under items in **Sections 7.8.2.2**, **7.8.2.3**, and **7.8.2.4** of these Pricing Criteria.

.4 An exception is allowed for field supervision labor on items in **Section 7.8.2.10.2**, for those portions of the Change Order Work that will be performed, or was performed, at times when the superintendent is not required to be on Site under **Section 6.4**, including but not limited to overtime hours due to acceleration and extensions of the Contract Times. Recovery for this matter will be allowed on an hourly basis under items in **Sections 7.8.2.2**, **7.8.2.3**, and **7.8.2.4** of these Pricing Criteria.

7.8.2.11 Contractor's Fee. Any cost or credit arising from a change in the Work shall include an allowance for the Contractor's Fee equal to **(1)** ten percent times **(2)** the sum of the costs described under **Sections 7.8.2.1** through **7.8.2.10** that are associated with that changed Work.

7.8.2.12 Miscellaneous. Any cost or credit arising from a change in Work may include the following costs with no allowance for Contractor's Fee under **Section 7.8.2.11** or Subcontractor overhead and profit under **Section 7.8.2.10**.

.1 The premium portion only for approved overtime (labor and fringes). The straight time portion is included in items in **Sections 7.8.2.2**, **7.8.2.3**, and **7.8.2.4**.

.2 State sales tax shall be allowed on items as defined by **Section 12.7**.

7.8.3 Costs that shall not be reimbursed for changes in the Work include the following:

7.8.3.1 Voluntary employee deductions including, but not limited to, deductions for charitable donations or U.S. savings bonds.

7.8.3.2 Employee profit sharing.

7.9 Time Extension

7.9.1 Every adjustment of the Contract Times associated with any change in the Work shall be determined as provided in this **Section 7.9**, which establishes the Contractor's maximum entitlement for any change in the Work, including without limitation all adjustments for interference, delay, hindrance, disruption of, or impact on the Work. This **Section 7.9** also governs time adjustments for deduct Change Orders and the Contractor's entitlement to additional time through the Change Directive, Change Request, Claims, and dispute resolution processes on account of changes in the Work.

7.9.2 The Contractor shall substantiate all changes in the Contract Times with:

7.9.2.1 a written description of the nature of the interference, disruption, hindrance, or delay;

7.9.2.2 identification of Persons and events responsible for the interference, disruption, hindrance, or delay;

7.9.2.3 date or anticipated date of commencement of the interference, disruption, hindrance, or delay;

7.9.2.4 identification of activities by schedule activity number and name on the Construction Progress Schedule, which may be affected by the interference, disruption, hindrance, or delay, or new activities created by the interference, disruption, hindrance, or delay and the relationship with existing activities;

7.9.2.5 anticipated duration of the interference, disruption, hindrance, or delay and of any remobilization period;

7.9.2.6 specific number of days of extension requested and specific number of days for remobilization requested;

7.9.2.7 recommended action to avoid or minimize any future interference, disruption, hindrance, or delay; and

7.9.2.8 If the Contracting Authority requests, a Proposal as described under **Section 7.8** for an increase in the Contract Sum which would fully compensate the Contractor for all costs of acceleration of the Work needed to completely overcome the associated delay, if any.

7.9.3 If the Contracting Authority requests, in addition to the requirements under **Section 7.9.2**, the Contractor shall also substantiate changes in the Contract Times with a prospective time-impact analysis (in native format), which illustrates the influence of each change on all affected Milestones and all affected activities. The Contractor shall submit the time-impact analysis within 30 days after the Contracting Authority requests, unless the Contracting Authority and Contractor agree otherwise.

7.9.3.1 The Contractor shall prepare the time-impact analysis consistent with a currently published, recognized standard for construction schedule analysis.

7.9.3.2 The Contractor shall prepare the time-impact analysis on the basis of **(1)** the last Construction Progress Schedule the Contracting Authority approved before the first day of the delay which is the subject of the analysis or **(2)** an interim update of the Construction Progress Schedule if the Contracting Authority determines that the period between the last approved Construction Progress Schedule and first day of the delay which is the subject of the analysis is too long.

7.9.3.3 The time-impact analysis shall include a fragmentary network analysis (fragnet), which **(1)** illustrates the sequence of new activities, activity revisions, or both, that the Contractor proposes to add to the Construction Progress Schedule upon which the time-impact analysis is based and **(2)** mathematically and graphically demonstrates the influence and proper measurement of the delay and how the Contractor proposes to incorporate that delay into the Construction Progress Schedule.

7.9.3.4 The time-impact analysis shall include a written narrative of the analysis.

7.9.4 Critical Path. Time extensions shall depend upon the extent to which the Work on the critical path of the Construction Progress Schedule is affected, if applicable.

7.9.4.1 A Change Order granting a time extension may provide that the Contract Times shall be extended for only those specific elements so interfered with, disrupted, hindered, or delayed and related remobilization and that remaining Milestone dates shall not be altered and may further provide for adjustment of Liquidated Damages.

7.10 Weather Delays

7.10.1 The parties expect adverse weather to delay the Work to some extent, and have included in the Contract Times a certain number of Work Days lost on account of adverse weather as follows:

Month	Expected Number of Work Days Lost Due to Weather
January	8
February	8
March	7
April	6
May	5
June	5
July	4
August	4

September	5
October	6
November	6
December	6

7.10.2 The Contractor will not be entitled to an extension of the Contract Times on account of adverse weather unless the actual number of Work Days lost due to adverse weather in a particular calendar month exceed the expected number of Work Days lost in that calendar month due to adverse weather. The Contractor shall reconcile lost Work Days with the A/E on a weekly basis.

7.10.3 A Work Day will be "lost" if adverse weather reduces the Contractor's efficiency on the Work on the critical path that Work Day to less than 50%. The Contractor shall substantiate its claim that its efficiency on the Work on the critical path that Work Day was less than 50%.

7.10.4 If the Contractor reasonably believes that it is entitled to an extension of the Contract Times on account of Work Days lost due to adverse weather in a particular month, the Contractor shall initiate a Change Request **(1)** as required under **Section 7.6,** and **(2)** within the time period required under **Section 7.6** which begins to run on the last calendar day of that month.

7.11 Examination and Audit of Contractor's Records

7.11.1 The Contracting Authority and Owner may examine all books, records, documents and other data of the Contractor and its Subcontractors related to the bidding, pricing, or performance of the Work for the purpose of evaluating any Contractor Payment Request, Proposal, Modification, or Claim.

7.11.2 The above referenced materials shall be made available at the office of the Contractor or Subcontractor, as applicable, at all reasonable times for inspection, audit, and reproduction until the expiration of ten years after the date of Substantial Completion of all Work.

7.11.2.1 The Contractor shall maintain and require its Subcontractors to maintain complete and accurate business records at its principal place of business. If the principal place of business is greater than 50 miles from the Site, the Contractor shall timely make records available, and shall require its Subcontractors to timely make records available, at the office of the Contracting Authority or Owner upon request for the records.

7.11.3 To the extent that the Contractor or Subcontractor, as applicable, informs the Contracting Authority or Owner in writing that any documents provided to the Contracting Authority or Owner are trade secrets, the Contracting Authority or Owner shall treat those documents, to the extent permitted by Applicable Law, as trade secrets of the Contractor or Subcontractor, as applicable.

7.11.3.1 If a dispute arises with any other Person about whether that Person should be given access to the documents, the Contractor or Subcontractor as applicable, shall indemnify the Contracting Authority and Owner against all costs, expenses, and damages, including but not limited to attorneys' fees, incurred or paid by reason of that dispute.

7.11.4 The right of inspection, audit, and reproduction extends to all documents necessary to permit adequate evaluation of the cost of pricing data submitted along with the computations and projections used therein.

7.11.5 If the Contract has been terminated in whole or in part, the records relating to the Work terminated shall be made available to the Contracting Authority or Owner for a period of ten years from the date of any applicable final settlement or payment, as applicable.

7.11.6 Records that relate to disputes, litigation, or settlement of Claims arising out of the performance of the Work shall be made available until the dispute, litigation or Claims have been finally decided or settled.

ARTICLE 8 - DISPUTE RESOLUTION

8.1 Initiation of a Claim

8.1.1 Every Claim shall accrue upon the date of occurrence of the event giving rise to the Claim.

8.1.2 The Contractor shall initiate every Claim by giving written notice of the Claim to the A/E and Contracting Authority within ten days after occurrence of the event giving rise to the Claim, including:

8.1.2.1 with regard to a Change Directive, the ten-day time limit on initiating a Claim begins to run on the earlier of the date that **(1)** the Contracting Authority issues its determination under **Sections 7.3.8** or **7.3.12; (2)** the A/E issues

a Change Order to the Contractor under **Sections 7.3.8** or **7.3.12**; **(3)** the Contracting Authority rejects the Contractor's Proposal in whole or in part under **Section 7.3.13**; or **(4)** the Contracting Authority is deemed to have rejected the Contractor's Proposal in whole or in part under **Section 7.3.14**; and

8.1.2.2 with regard to a Change Request, the ten-day time limit on initiating a Claim begins to run on the earlier of the date that **(1)** the Contracting Authority issues its determination under **Section 7.6.5**; **(2)** the A/E issues a Change Order to the Contractor under **Section 7.6.5**; **(3)** the Contracting Authority rejects the Contractor's Proposal in whole or in part under **Section 7.6.6**; or **(4)** the Contracting Authority is deemed to have rejected the Change Request in whole or in part under **Section 7.6.7**.

8.1.3 The Contractor's written notice of a Claim shall provide the following information to permit timely and appropriate evaluation of the Claim, determination of responsibility, and opportunity for mitigation:

8.1.3.1 nature and anticipated amount of the impact, including all costs for any interference, disruption, hindrance, or delay, which shall be calculated in accordance with **Section 7.8** and be a fair and reasonably accurate assessment of the damages suffered or anticipated by the Contractor;

8.1.3.2 identification of the circumstances responsible for causing the impact, including, but not limited to, the date or anticipated date, of the commencement of any interference, disruption, hindrance, or delay;

8.1.3.3 identification of activities on the Construction Progress Schedule that will be affected by the impact or new activities that may be created and the relationship with existing activities;

8.1.3.4 anticipated impacts and anticipated duration of any interference, disruption, hindrance, delay, or impact, and any remobilization period;

8.1.3.5 the Contractor's completed and planned actions to mitigate damages by avoiding interference, disruption, hindrance, delay, or impact; and

8.1.3.6 recommended action to avoid or minimize any interference, disruption, hindrance, delay, or impact.

8.1.4 The Contractor's failure to initiate a Claim as and when required under this **Section 8.1** will constitute the Contractor's irrevocable waiver of the Claim.

8.2 Substantiation of Claims – General Requirements

8.2.1 Within 30 days after the initiation of a Claim, the Contractor shall submit three copies of all information and statements required to substantiate a Claim as provided in this **Article 8** and all other information that the Contractor believes substantiates the Claim. The Contractor shall file the three copies by delivering one copy to the A/E, one copy to the Owner, and one copy to the Contracting Authority.

8.2.2 The Contractor shall substantiate all of its Claims by providing the following minimum information:

8.2.2.1 a narrative of the circumstances, which gave rise to the Claim, including without limitation the start date of the event or events and the actual or anticipated finish date;

8.2.2.2 detailed identification of the Work (e.g., activity codes from the Construction Progress Schedule) affected by the event giving rise to the Claim;

8.2.2.3 copies of the Contractor's daily log (**Section 6.2.14**) for each day of impact;

8.2.2.4 copies of relevant correspondence and other information regarding or supporting Contractor entitlement;

8.2.2.5 copies of the Contractor's most-recent income statement and complete and detailed job-cost report, including segregated general and administrative expenses for the most-recent reporting period, and for the period of the Contract, if available, and similar information for any Subcontractor claim included; and

8.2.2.6 the notarized certification described under **Section 8.5.1.1**.

8.2.3 The Contractor's failure to comply with the requirements of this **Section 8.2** will constitute an irrevocable waiver of any related Claim.

8.3 Substantiation of Claims – Increase of the Contract Sum

8.3.1 The Contractor shall substantiate each Claim for an increase of the Contract Sum with:

8.3.1.1 written documentation as described under **Section 7.8** of the actual additional costs to the Contractor due to the event giving rise to the Claim; and

8.3.1.2 the general substantiation documentation described under **Section 8.2**.

8.3.2 The Contractor's failure to comply with the requirements of this **Section 8.3** will constitute an irrevocable waiver of any related Claim.

8.4 Substantiation of Claims – Extension of the Contract Times

8.4.1 The Contractor shall substantiate each Claim for an extension of the Contract Times with:

8.4.1.1 written documentation as described under **Section 7.9** of the actual delay to the critical path of the Construction Progress Schedule due to the event giving rise to the Claim;

8.4.1.2 a Proposal as described under **Section 7.8** for an increase in the Contract Sum that would fully compensate the Contractor for all costs of acceleration of the Work needed to completely overcome the associated delay together with a statement consistent with **Section 8.3.1.1**; and

8.4.1.3 the general substantiating documentation described under **Section 8.2**.

8.4.2 The Contractor's failure to comply with the requirements of this **Section 8.4** will constitute an irrevocable waiver of any related Claim.

8.5 Certification of the Claim

8.5.1 The Contractor shall certify each Claim within 30 days after initiating the Claim under **Section 8.1** by providing the notarized certification specified in **Section 8.5.1.1**, signed and dated by the Contractor:

8.5.1.1 "The undersigned Contractor certifies that the Claim is made in good faith; that the supporting data is accurate and complete to the best of the Contractor's knowledge and belief; that the amount of money, time, or both requested is a fair, reasonable, and necessary adjustment; that the amount of money, time, or both requested is the entire amount of money, time, or both to which the Contractor is entitled on account of the Claim; and that the undersigned is duly authorized to certify the Claim on behalf of the Contractor."

8.5.2 The date that the Contractor's certified and fully substantiated Claim is received by the Contracting Authority, or the date that the Contractor is required to certify and fully substantiate a Claim pursuant to **Sections 8.2.1** and **8.5.1**, shall trigger the 120-day period for exhaustion of administrative remedies pursuant to ORC Section 153.16(B).

8.5.3 The Contractor's failure to comply with the requirements of this **Section 8.5** will constitute an irrevocable waiver of any related Claim.

8.6 Delay and Delay Damage Limitations; Derivative Claims

8.6.1 Subject to other provisions of the Contract, the Contractor will be entitled only to an extension of the Contract Times on account of delay in the commencement or progress of Work on the critical path of the Construction Progress Schedule caused by acts of Nature or the public enemy, acts of the government not arising from the Contractor's failure to comply with Applicable Law, fires, floods, epidemics, weather, and labor disputes beyond the Contractor's control.

8.6.2 Notwithstanding any other provision of the Contract Documents to the contrary, the Contractor shall not be entitled to an increase in the Contract Sum, or an extension of the Contract Times, or both:

8.6.2.1 on account of the impact of any normal adverse weather on any of the Work or on account of the impact of any abnormal adverse weather as indicated under **Section 7.10** on Work not on the critical path;

8.6.2.2 to the extent that a delay occurs concurrently with a delay attributable to the Contractor; or

8.6.2.3 on account of the delay of any Work not on the critical path.

8.6.3 Notwithstanding any other provision of the Contract Documents to the contrary, the Contractor shall not be entitled to an increase in the Contract Sum or any type of damages on account of a delay in the commencement or progress of Work on the critical path unless **(1)** the delay is caused by the Owner and **(2)** the delay was not authorized or permitted under the Contract.

8.6.4 Notwithstanding any other provision of the Contract Documents to the contrary, the Contractor shall not be entitled to an increase in the Contract Sum or any type of damages arising from a delay in the commencement or progress of any of the Work caused by the occurrence or non-occurrence of an event beyond the Owner's control such as acts of Nature or the public enemy, acts of the government, fires, floods, epidemics, labor disputes, unusual delivery delays, weather, or damages caused by the Contractor.

8.6.5 Derivative Claims. Notwithstanding any other provision of the Contract to the contrary, if the Owner prosecutes a claim, suit, or appeal against a Separate Consultant or Separate Contractor to recover damages the Contractor suffers on account of the acts or neglects of a Separate Consultant or Separate Contractor or a person or entity for whom either is

legally responsible, the Owner's liability to the Contractor shall not exceed the amount the Owner actually recovers from the Separate Consultant or Separate Contractor on account of those damages less the costs the Owner incurs recovering them. The Owner is not obligated to prosecute any such claim, suit, or appeal.

8.7 Liquidated Damages

8.7.1 If the Contractor fails to achieve a Milestone within the associated Contract Time, it would be difficult, if not impossible, to determine the Owner's resulting damages. Therefore, if the Contractor fails to achieve a Milestone within the associated Contract Time, the Contractor shall (at the Owner's option) pay to or credit the Owner the Liquidated Damages per day sum determined according to the following schedule for each day that the Contractor fails to achieve a Milestone within the associated Contract Time. If the Project involves more than one Phase as explicitly identified in the Agreement, the Contract Sum in the below schedule refers to the total Contract Sum for each of the Phases individually as opposed to the aggregate Contract Sum for all Phases.

Contract Sum	Liquidated Damages per day for Milestones other than the Punch List Milestone	Liquidated Damages per day for the Punch List Milestone
Less than $1,000,000	$500	$125
From $1,000,000.01 to $2,000,000	$1,000	$250
From $2,000,000.01 to $5,000,000	$2,000	$500
From $5,000,000.01 to $10,000,000	$5,000	$1,250
From $10,000,000.01 to $20,000,000	$7,500	$1,875
From $20,000,000.01 to $50,000,000	$10,000	$2,500
More than $50,000,000	$15,000	$3,750

8.7.2 The Liquidated Damages described in this **Section 8.7** are only intended to compensate the Owner for the damages it incurs as a direct result of the Contractor's failure to achieve the Milestones within their associated Contract Times.

8.7.3 The Liquidated Damages described in this **Section 8.7** are not intended to compensate the Owner for any damages the Owner incurs on account of **(1)** any claims attributable to the Contractor that are brought by others including Separate Consultants and Separate Contractors as a result of the Contractor's failure to achieve the Milestones within their associated Contract Times or **(2)** any failure of the Contractor to timely, properly, and completely perform the Contract other than the failure to achieve the Milestones within their associated Contract Times.

8.7.4 The parties acknowledge that the above-listed Liquidated Damages per day sums are not penalties but are a reasonable estimate of the damages the Owner itself would incur as a direct result of the Contractor's failure to achieve the Milestones within their associated Contract Times. The parties each irrevocably waive the right (if any) to challenge the validity and enforceability of those Liquidated Damages per day sums. Notwithstanding any other provision of the Contract Documents to the contrary, if a court determines that the Liquidated Damages per day sums or their application are void and unenforceable, the Owner shall be entitled to recover the actual damages that it incurs on account of the Contractor's failure to achieve one or more of the Milestones within the Contract Times.

8.7.5 In addition to other rights that the Owner may have relative to the Liquidated Damages, the Contracting Authority may deduct Liquidated Damages from the Contract Sum as the damages accrue. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall immediately pay the amount of the insufficiency to the Owner.

8.8 Mutual Waiver of Consequential Damages

8.8.1 Except as provided under **Section 8.8.2**, the Owner and Contractor each waive against the other all Claims for consequential damages that may arise out of or relate to this Contract.

8.8.1.1 The Owner's waiver includes Claims for loss of use, income, profit, revenue, financing, cost of capital, business and reputation, management and employee productivity, and consequential damages arising from termination of the Contract or related to insolvency.

8.8.1.2 The Contractor's waiver includes Claims for unabsorbed home-office overhead; any other form of overhead in excess of that specifically provided for under **Section 7.8**; delay damages except as otherwise specifically provided for in **Section 8.6**; increased cost of funds for the Project; lost opportunity to work on other projects; losses of financing, business, and reputation; loss of profit except anticipated profit arising directly from properly performed Work; loss of bonding capacity; and consequential damages arising from termination of the Contract or related to insolvency.

8.8.2 Notwithstanding **Section 8.8.1**, this **Section 8.8**:

8.8.2.1 does not apply to any damages that would be covered by insurance provided in connection with the Project if the Contract did not include **Section 8.8.1;**

8.8.2.2 does not apply to the Contractor's indemnity obligations for third-party claims against the Indemnified Parties even if those claims are for damages that **Section 8.8.1** would otherwise preclude;

8.8.2.3 does not preclude the Owner's recovery of Liquidated Damages under **Section 8.7**; and

8.8.2.4 does not apply to Claims for damages arising from the Owner's or the Contractor's gross negligence or willful misconduct.

8.8.3 This **Section 8.8** shall survive termination of the Contract.

8.9 Review of the Claim

8.9.1 The A/E shall review the Claim and prepare a written analysis of its content, which shall include:

8.9.1.1 a narrative of the A/E's examination of the facts giving rise to the Claim;

8.9.1.2 identification of relevant Contract Documents and language;

8.9.1.3 an analysis of whether the Contractor complied with the requirements of the Contract Documents pertaining to Claim initiation and substantiation including, without limitation, the issues of entitlement to, and calculation of, adjustments of the Contract Sum, Contract Times, or both;

8.9.1.4 an analysis of claimed additional labor, materials, and equipment for the scope of the Work items described;

8.9.1.5 an analysis of any time extension for any interference, disruption, hindrance, impact, or delay claimed (to include the calculation of any concurrent delays affecting entitlement);

8.9.1.6 a concluding opinion regarding Contractor entitlement to, and the appropriateness and reasonableness of all, or any part of, the Claim; and

8.9.1.7 an appendix containing copies of contemporaneous documentation supporting the concluding opinion.

8.9.2 The A/E shall submit the written analysis to the Project Manager no more than 30 days after receiving the Contractor's substantiated and certified Claim.

8.10 Claim Decision

8.10.1 The Project Manager shall examine the Contractor's Claim and A/E's analysis.

8.10.2 The Project Manager shall approve or deny all, or any part, of the Contractor's Claim and forward a written decision to the Contractor, A/E, Owner, and Contracting Authority within 14 days after receiving the A/E's analysis. The Project Manager may employ independent resources to assist in its review, or refer evaluation of the Claim to a consultant.

8.10.3 If the Contractor and Owner agree with the Project Manager's decision, the decision shall be incorporated into a Change Order.

8.10.4 Any Claim remaining unresolved after completion of the process described under this **Section 8.10** shall be subject to Claim decision review as described under **Section 8.11**.

8.11 Claim Decision Review

8.11.1 The Contractor may request review of the Project Manager's decision by written notice delivered by certified mail within 14 days after the Project Manager's decision.

8.11.1.1 If the Project is administered by the Commission, jointly administered by the Commission and a public school district, or locally administered by authority granted to an agency of the state of Ohio by the Commission, the written notice shall be delivered to the Executive Director of the Commission.

8.11.1.2 If the Project is locally administered by an Institution of Higher Education under ORC Section 3345.50 or ORC Section 3345.51, the written notice shall be delivered to the Institutional Designee who will review the Project Manager's decision instead of the Commission.

8.11.2 The Commission or Institutional Designee, as applicable, shall schedule and conduct a meeting within 30 days after receiving the Contractor's request for review. The Commission or Institutional Designee may employ independent resources to assist in the meeting and review.

8.11.3 The Commission or Institutional Designee, as applicable, shall determine the final disposition of the Contractor's request for review and provide a written decision to the Contractor and Owner within 14 days after the meeting.

8.11.4 The decision of the Commission or Institutional Designee is the final administrative decision of the Contracting Authority as described under ORC Section 153.12(B).

8.11.5 If the Contractor and Owner agree with the Commission's or the Institutional Designee's decision, the decision shall be incorporated into a Change Order.

8.11.6 Any Claim remaining unresolved after completion of the process described under this **Section 8.11** shall be subject to litigation, which may be preceded by Alternative Dispute Resolution ("ADR") as described under **Section 8.13**.

8.12 Delegation

8.12.1 No provision of this **Article 8** shall prevent the Executive Director from delegating the duties or authorities of the Commission to any other person selected at the Executive Director's sole discretion.

8.13 Alternative Dispute Resolution

8.13.1 At any point in the Claims and dispute-resolution processes, the Project's key stakeholders may agree to enter into non-binding ADR including progressive negotiation, dispute review board, mediation, or another non-binding ADR procedure accepted by all of the Project's key stakeholders.

8.14 Audit of the Claim

8.14.1 All Claims shall be subject to audit at any time following filing of the Claim, whether or not the Claim is part of a lawsuit.

8.14.2 The audit may be performed by employees of the Contracting Authority or by a consultant engaged by the Contracting Authority.

8.14.3 The audit may begin upon ten-days' notice to the Contractor or affected Subcontractor.

8.14.4 The Contractor shall cooperate with the request.

8.14.5 Failure of the Contractor or Subcontractor to produce sufficient records to allow the Contracting Authority to audit and verify a Claim will constitute an irrevocable waiver of the Claim or portion of the Claim that could not be completely audited.

8.14.6 The Contractor shall make available to the Contracting Authority all Contractor and Subcontractor documents related to the Claim including, without limitation, the following documents:

8.14.6.1 daily time sheets and superintendent's daily reports;

8.14.6.2 union agreements, if any, and employer agreements;

8.14.6.3 insurance, welfare, fringes, and benefits records;

8.14.6.4 payroll register;

8.14.6.5 earnings records;

8.14.6.6 payroll tax returns;

8.14.6.7 material invoices, purchase orders, Subcontracts, and all material and supply acquisition contracts;

8.14.6.8 material cost distribution worksheets;

8.14.6.9 equipment records (list of Contractor equipment, rates, etc.);

8.14.6.10 vendor rental agreements and Subcontractor invoices;

8.14.6.11 Subcontractor payment certificates;

8.14.6.12 canceled checks (payroll and vendors);

8.14.6.13 complete and detailed job-cost report;

8.14.6.14 job payroll ledger;

8.14.6.15 general ledger, general journal (if used), and all subsidiary ledgers and journals together with all supporting documentation pertinent to entries made in those ledgers and journals;

8.14.6.16 cash disbursements journal;

8.14.6.17 financial statements for all years reflecting operations on the Project;

8.14.6.18 income tax returns for all years reflecting operations on the Project;

8.14.6.19 depreciation records on all equipment utilized whether the records are maintained by the Contractor, its accountant, or others;

8.14.6.20 if a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating equipment, all other source documents;

8.14.6.21 all documents that reflect the Contractor's actual profit and overhead during the years the Project was being performed;

8.14.6.22 all documents related to the preparation of the Contractor's Bid(s), including the final calculations on which the Bid was based, unless the documents are placed in escrow under provisions of the Instructions to Bidders;

8.14.6.23 all documents that relate to the Claim together with all documents that support the amount of damages as to the Claim;

8.14.6.24 worksheets used to prepare the Claim establishing the cost components for items of the Claim including, but not limited to, labor, fringes, benefits and insurance, materials, equipment, Subcontractors, and all documents that establish the periods of time, individuals involved, the hours and rate of pay for the individuals; and

8.14.6.25 all other documents required by the Contracting Authority to reasonably review the Claim.

8.15 False Certification of the Claim

8.15.1 If the Contractor falsely certifies all or any part of a Claim, the portion of the Claim falsely certified shall be denied, and may be sufficient cause for the State to debar the Contractor from future State contracting opportunities as permitted by Applicable Law.

8.16 Performance and Payment

8.16.1 The Contractor shall proceed with the Work during any dispute resolution process, unless otherwise agreed by the Contractor and Contracting Authority in writing.

8.16.2 The Contracting Authority shall continue to make payment of any undisputed amounts in accordance with the Contract Documents pending final resolution of a Claim, unless otherwise agreed by the Contractor and Contracting Authority in writing.

ARTICLE 9 - COMPENSATION AND PAYMENT

9.1 Allowances

9.1.1 The Contract Sum includes the Allowances (if any) identified in the Contract.

9.1.2 Unless otherwise explicitly stated in the Agreement, Allowance amounts cover all compensation to which the Contractor would be entitled for completing the associated Work, including without limitation the cost to the Contractor (less any applicable trade discounts) of materials and equipment required by the Allowances delivered, unloaded, handled, and installed at the Site; all associated labor costs of every kind; all applicable taxes; and the Contractor's Fee.

9.1.3 Before final payment, an appropriate Change Order will be issued to reconcile the Contract Sum so that it reflects actual amounts due to the Contractor on account of Work covered by Allowances.

9.2 Unit Prices

9.2.1 Unless otherwise explicitly stated in the Agreement:

9.2.1.1 The Contract Sum includes the Unit Price Work (if any) identified in the Agreement.

9.2.1.2 Where the Contract provides that all or part of the Work is to be Unit Price Work, initially the Contract Sum will include for all Unit Price Work **(1)** an amount equal to the sum of the established Unit Prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Contract plus **(2)** the Contractor's Fee, which is included in the Unit Prices.

9.2.1.3 The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Sum. The Contracting Authority will determine the actual quantities and classifications of Unit Price Work performed by Contractor.

9.2.2 Before final payment, an appropriate Change Order will be issued as described under **Section 7.1.5** to reconcile the Contract Sum so that it reflects actual amounts due to the Contractor on account of Unit Price Work actually performed including an associated adjustment on account of the Contractor's Fee.

9.3 Schedule of Values

9.3.1 Within ten days after receipt of the Notice to Proceed, or other period as mutually agreed by the Contractor and Contracting Authority, the Contractor shall submit to the A/E a Schedule of Values on a form published by the Commission, with separate amounts shown for labor and materials for each branch of Work, following the numbers and titles of the Construction Specifications Institute's *MasterFormat* for individual work results, or *UniFormat* for assemblies in place.

9.3.1.1 The Contractor shall clearly indicate on the Schedule of Values, the amount(s) allocated, including separate items for Contractor's Fee, for each EDGE-certified Business used in the performance of the Work. The amount(s) shall indicate labor and materials, as appropriate, and separate items for Contractor's Fee.

9.3.2 The grand total shown on the Schedule of Values shall equal the total Contract Sum. The Contracting Authority may use the approved Schedule of Values to determine the cost or credit to the Owner resulting from any change in the Work.

9.3.2.1 The first items shall be a breakdown of General Conditions Costs.

9.3.2.2 The amounts for labor and materials shall accurately reflect the cost for each item and include Contractor's Fee. Separate line items shall not be shown for Contractor's Fee, except as provided under **Section 9.3.1.1**.

9.3.2.3 If the material allocation exceeds 55 percent of the Contract Sum, the Contractor shall provide, upon request, sufficient information to support the higher percentage.

9.3.2.4 Subcontract Work shall show amounts for labor and materials. Fringe benefits shall be shown as a part of labor costs.

9.3.2.5 When more than one major structure is included in the Work, the Contractor shall subdivide the Schedule of Values accordingly, with cost details for each structure shown separately.

9.3.2.6 The line items shall be coordinated with line items in the Project Schedule, which may require division of items of Work by area of the Project by floor, phase, or other appropriate area.

9.3.2.7 Mechanical and electrical Work shall be included in separate line items for all major pieces of equipment, and group smaller equipment items by type.

9.3.2.8 Line items shall be included for each Allowance, Coordination Drawings, Punch List Work, Project Record Document Submittals, delivery of attic stock, and specified demonstrations and training.

9.3.3 The A/E may return the Schedule of Values to the Contractor for re-submittal if it does not meet the requirements or contains insufficient items or details of the Work, or approve the Schedule of Values if the A/E determines that it conforms to this **Section 9.3**.

9.3.4 No payment shall be made until the A/E has approved the Contractor's Schedule of Values.

9.4 Contractor Payment Request

9.4.1 After the Date of Commencement, the Contractor may request payment of the Contract Sum. The Owner will pay the Contract Sum to the Contractor on a percent-complete progress basis.

9.4.2 The Contractor may submit a Contractor Payment Request to the A/E each month or upon another interval approved by the Contracting Authority. When the rate of Work and amount involved is sufficient that it is considered appropriate by the Contracting Authority, the Contractor may submit Contractor Payment Requests twice a month. The Contractor shall base each Contractor Payment Request on the Schedule of Values current as of the date that the Contractor submits the Contractor Payment Request.

9.4.2.1 The Contractor shall support each Contractor Payment Request with documentation substantiating the Contractor's right to payment. The Contractor shall supply additional documentation as the A/E may request in connection with each payment to the Contractor.

9.4.2.2 The Contracting Authority may require proof of the renewal of required insurance as a condition precedent to payment.

9.4.2.3 The Contractor shall attach certified payroll reports for the relevant period to one copy of each Contractor Payment Request, see **Document 00 73 43 - Prevailing Wage Requirements**.

9.4.2.4 The Contractor may list on the Contractor Payment Request any Change Orders approved and performed prior to submission of the Contractor Payment Request.

9.4.2.5 The Contractor shall submit its Contractor Payment Request using the Contractor Payment Request form or forms current at the time of each application and as provided by the Contracting Authority in the manner prescribed by the Contracting Authority.

9.4.2.6 The Contractor shall submit one draft copy of its Contractor Payment Request ("Pencil Copy") to the A/E not less than one week prior to submitting multiple copies of its Contractor Payment Request. The A/E shall review the Pencil Copy and provide comments to the Contractor within three days after receiving it. The Contractor shall incorporate the A/E's comments into its Contractor Payment Request prior to submitting multiple copies for payment.

9.4.2.7 The Contractor shall clearly indicate on the Contractor Payment Request, the amount(s) requested for each EDGE-certified Business used in the performance of the Contract. The amount(s) shall indicate labor and materials, as appropriate.

9.4.2.8 The Contractor shall submit an electronic copy of the Contractor Payment Request to the A/E with its paper copies of the Contractor Payment Request for collection and reporting of information used for contract compliance evaluation and statistical purposes. The Contractor may issue the copy in any electronic media acceptable to the Contracting Authority.

9.4.3 Payments for Unit Price Work shall be made to the Contractor only for the authorized actual quantities of Work performed or materials furnished in accordance with the Contract Documents.

9.4.4 Subject to **Section 9.8**, the Owner shall pay an approved Contractor Payment Request within 30 days after the date the A/E recommends acceptance of the Contractor Payment Request.

9.5 Retainage on Labor Payments

9.5.1 Partial payments to the Contractor for labor shall be made at the rate of 96 percent of the amount invoiced through the Contractor Payment Request.

9.5.2 If the Project involves more than one Phase as explicitly identified in the Agreement, this **Section 9.5** will apply on a per-Phase basis.

9.6 Release of Retainage on Labor Payments

9.6.1 When the Contractor has achieved Substantial Completion of all Work, and there is no other reason to retain funds, the retained funds shall be paid to the Contractor within 30 days after the Contractor's request, except to the extent necessary, in the Contracting Authority's sole discretion, to assure the Contractor's faithful completion of the Work including but not limited to compliance with **Section 6.26.2**.

9.6.2 Upon consent of the Contractor's Surety, the Contracting Authority may reduce the amount of funds retained for the faithful performance of Work by up to 50 percent of the amount of funds required to be retained, provided the Contractor's Surety remains responsible for all damages that may be caused due to default by the Contractor, including, but not limited to, the following:

9.6.2.1 completion of the Work;

9.6.2.2 all interference, disruption, hindrance, and delay claims;

9.6.2.3 all Liquidated Damages; and

9.6.2.4 all additional expenses incurred by the State.

9.6.3 Funds retained until Contract Completion will be paid to the Contractor as described under **Section 6.31.2.**

9.6.4 If the funds retained under **Section 9.5** accrued interest while withheld from the Contractor, the payments of those retained funds to the Contractor will include that accrued interest.

9.6.5 If the Project involves more than one Phase as explicitly identified in the Agreement, this **Section 9.6** will apply on a per-Phase basis.

9.7 Retainage on Material Payments

9.7.1 The Owner shall pay the Contractor at the rate of 100 percent of the scheduled value for materials incorporated into the Project.

9.7.2 The Owner shall pay the Contractor at the rate of 92 percent of the invoice cost, not to exceed the scheduled value , for materials delivered to the Site, or other off-site storage location approved by the A/E, provided the Contractor provides the following information with the Contractor Payment Request:

9.7.2.1 a list of the fabricated materials consigned to the Project, giving the place of storage, together with copies of invoices verifying quantity and cost, written evidence of insurance covering the off-site stored materials; and

9.7.2.2 a certification of materials stored off-site, prepared by the Contractor and signed by the A/E to evidence that the materials are in conformity with the Specifications and have been tagged with the Project name and number for delivery to the Project. The Contractor shall directly reimburse the A/E for all costs incurred to visit a storage site, other than the areas adjacent to the Project.

9.7.3 The Owner shall pay the balance of the scheduled value when the materials are incorporated into and become a part of the Project.

9.7.4 When payment is allowed for materials delivered to the Site or other approved off-site storage location but not yet incorporated into the Project, the materials are the property of the Owner.

9.7.4.1 The Owner may, at its sole discretion, retain any material not ultimately incorporated into the Project or return it to the Contractor for credit of an amount proportionate to the value of the extra materials.

9.8 Payments Withheld

9.8.1 The A/E may recommend to the Contracting Authority that payments be withheld from, or Liquidated Damages be assessed against, a Contractor Payment Request.

9.8.2 The Contracting Authority may reject any Contractor Payment Request or part thereof, or withdraw any previous Contractor Payment Request, in whole or in part, to the extent necessary in the Contracting Authority's sole opinion to protect the Owner from loss because of:

9.8.2.1 Defective Work not remedied;

9.8.2.2 damage caused by the Contractor;

9.8.2.3 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

9.8.2.4 reasonable evidence that the Work will not be completed within the Contract Times, and that the unpaid balance would not be adequate to cover damages under the Contract Documents for the anticipated delay;

9.8.2.5 failure to comply with Applicable Law including, but not limited to, the requirements of ORC Chapter 4115;

9.8.2.6 failure to timely submit EDGE Participation Reports in accordance with **Section 1.8.2**;

9.8.2.7 failure to timely identify the Contractor's proposed Subcontractors in accordance with **Section 4.1.1**;

9.8.2.8 failure to timely fulfill the Contractor's obligations related to the Construction Progress Schedule;

9.8.2.9 failure to carry out the Work in accordance with the Contract Documents; or

9.8.2.10 that which is permitted under other provisions of the Contract Documents.

9.8.3 The Contracting Authority shall notify the Owner, Contractor, and A/E in writing of the Contracting Authority's exercise of its rights under **Section 9.8.2**. If the Contractor remedies the basis for withholding payment under **Section 9.8.2** to the Contracting Authority's satisfaction, the Owner shall pay the amounts withheld.

9.8.4 If the Contractor takes exception to the withholding of payments under **Section 9.8.2**, the Contractor shall initiate a Claim as and when required under **Article 8**.

9.9 Final Contractor Payment Request

9.9.1 The Contractor, as a condition precedent to Contract Completion and final payment, shall complete all requirements of the Contract Documents.

9.9.1.1 The Contractor and each of its Subcontractors, regardless of tier, shall execute a Payment Release Affidavit to certify that the Contractor and each of its Subcontractors, regardless of tier, have complied with all requirements of ORC Chapter 4115, and to certify that all of its Subcontractors have been paid in full for all Work performed or materials furnished for the Project.

9.9.2 The Owner shall pay the final Contractor Payment Request within 30 days after the date the A/E recommends acceptance of the final Contractor Payment Request.

9.9.3 Acceptance of final payment by the Contractor or a Subcontractor constitutes the payee's waiver of all claims against the State except those previously made in writing under **Article 8** and identified by that payee as unsettled at the time of the final Contractor Payment Request.

ARTICLE 10 - BONDS, INSURANCE, AND INDEMNIFICATION

10.1 Payment and Performance Bonds

10.1.1 Before signing the Agreement, the Contractor shall provide the Bond required under Applicable Law and below:

10.1.1.1 If the Contractor provided **Document 00 43 13 - Bid Security Form** as its Bid Guaranty, then that form shall be the Bond.

10.1.1.2 If the Contractor provided another form of Bid Guaranty, then **Document 00 61 13 - Performance and Payment Bond Form** shall be the Bond.

10.1.1.3 Each Surety under the Bond shall be licensed to do business in Ohio and satisfactory to the Contracting Authority.

10.1.1.4 If there is more than one Surety under the Bond, each of them shall be jointly and severally liable as surety under the Bond.

10.1.1.5 Unless the Contracting Authority and the Owner are the same entity, the Bond shall name as co-obligees **(1)** the State by and through the Contracting Authority and **(2)** the Owner.

- **.1** If any document is used to name the required co-obligees of the Bond (e.g., a form commonly known as a "dual obligee rider"), that document will not alter the terms of the Contract in any way or the terms of the Bond in any way beyond merely naming the co-obligees notwithstanding any term of that document to the contrary.
- **.2** The Surety will not be obligated to more than the Penal Sum of any Bond solely on account of the existence of more than one obligee under that Bond.

10.1.1.6 The penal sum of the Bond, when initially submitted, shall be equal to one-hundred percent of the Contract Sum.

10.1.2 The Contractor shall submit with the executed Bond **(1)** a certified copy of the authority to act (power of attorney) of the agent signing the Bond on behalf of the Surety and **(2)** a current and signed Certificate of Compliance under ORC Section 9.311 issued by the Ohio Department of Insurance showing the Surety is licensed to do business in Ohio.

10.1.3 If the Contract Sum increases at any time such that it exceeds the penal sum of the Bond, the Contractor shall cause the penal sum of the Bond to be increased such that the penal sum equals one-hundred percent of the increased Contract Sum.

10.1.4 Any time the Contractor increases the penal sum of the Bond under **Section 10.1.3**, the Contractor shall deliver to the Contracting Authority an Acknowledgment of Surety from the affected Surety or Sureties to evidence the Surety's or Sureties' receipt of notice of the increased penal sum.

10.1.4.1 The Contracting Authority's receipt of the required Acknowledgement(s) of Surety is a condition precedent to the Owner's obligation to pay the Contractor for any portion of the Work associated with the increase of the penal sum.

10.1.4.2 The Contractor's failure to submit a required Acknowledgment of Surety or a Surety's failure or refusal to provide an Acknowledgment of Surety will not relieve the Surety of its obligation for the increased penal sum.

10.1.4.3 If any Surety fails or refuses to provide a required Acknowledgement of Surety, the Contracting Authority may require the Contractor to deliver to the Contracting Authority a new Bond showing the increased penal sum and written consent of the affected Surety or Sureties confirming the increased penal sum. In that event, the Contracting Authority's receipt of replacement Bonds will be a condition precedent to the Owner's obligation to pay the Contractor for any portion of the Work associated with the increase of the penal sum.

10.1.4.4 Each Acknowledgment of Surety shall be **(1)** on a form provided by the Contracting Authority and **(2)** subject to the acceptance of the Contracting Authority.

10.1.5 If at any time prior to final payment, any surety providing a Bond for the Project **(1)** is adjudged bankrupt or has made a general assignment for the benefit of its creditors; **(2)** has liquidated all assets or has made a general assignment for the benefit of its creditors; **(3)** is placed in receivership; **(4)** otherwise petitions a state or federal court for protection from its creditors; or **(5)** allows its license to do business in Ohio to lapse or to be revoked, then the Contractor shall, within 21 days after any such action listed above, provide the Contracting Authority with a new Bond in the form and

amount described in this **Section 10.1**. The Contracting Authority's receipt of a replacement Bond is a condition precedent to the Owner's obligation to pay the Contractor.

10.1.6 If notice of any change affecting the Contract is required by any Surety or by the provision of any Bond, the Contractor shall provide that notice.

10.2 Contractor's General Insurance Requirements

10.2.1 Throughout the performance of the Work or longer as may be described below, the Contractor shall obtain, pay for, and keep in force, the minimum insurance coverage described in this **Article 10**.

10.2.1.1 Each requirement of this **Article 10** applies to Subcontractors just as it applies to the Contractor.

10.2.1.2 If a Subcontractor's usual insurance coverage does not meet the minimum coverage requirements, before entering into an agreement with that Subcontractor, the Contractor shall submit to the Contracting Authority **(1)** a certificate of insurance evidencing the insurance the Subcontractor will carry without additional compensation and **(2)** if the Contracting Authority requests, a written proposal from the Subcontractor to provide coverage that meets the minimum coverage requirements. The Contracting Authority will decide whether to accept the non-conforming insurance coverage or the proposal to provide conforming coverage.

.1 Notwithstanding any other provision of the Contract to the contrary, the Contractor will not be entitled to any increase of the Contract Sum, Contract Times, or both on account of the Contracting Authority's refusal to accept a Subcontractor's nonconforming insurance coverage.

10.2.1.3 On a case-by-case basis, the Contracting Authority and Contractor may agree to adjust the below requirements for any particular Subcontractor.

10.2.2 Before starting the Work on the Site, upon renewal of any policy, and upon a change of any insurance carrier, the Contractor shall deliver to the Contracting Authority certificates evidencing that the required insurance is in force.

10.2.2.1 Certificates of insurance for other than government-controlled workers' compensation insurance shall identify **(1)** all below-required additional insureds and **(2)** the Project name.

10.2.3 With the exception of government-controlled workers' compensation coverage:

10.2.3.1 the Contractor shall place the insurance with companies that **(1)** are satisfactory to the Contracting Authority, **(2)** hold an A.M. Best Rating of A-, X, or higher, and **(3)** are authorized to conduct business in Ohio;

10.2.3.2 the policies shall be endorsed to require the Contractor's insurance carrier to **(1)** provide 30-days' written notice to the Contracting Authority (as certificate holder) of the cancellation or non-renewal of the insurance and **(2)** provide at least ten-days' written notice to the Contracting Authority (as certificate holder) of the cancellation of the insurance for non-payment of premium; and

10.2.3.3 within 30 days after the Contracting Authority's request, the Contractor shall submit insurance-company certified copies of the policies, the policy endorsements, loss-run reports, or all three.

10.2.4 The Contractor shall pay all deductibles, or self-insured retentions, or both contained in the Contractor's policies of insurance required or provided in connection with the Project. The Contracting Authority reserves the right to approve or reject all levels of self-insured retention, captive insurance programs, or other alternative risk financing the Contractor may use to comply with any insurance requirement.

10.2.5 The Contractor shall pay a proportionate share of the deductibles, or self-insured retentions, or both contained in any insurance policy the Contracting Authority purchases for the Project. The Contractor's proportionate share will derive from the percentage of the associated claim or loss attributable to the alleged or actual negligence of the Contractor or a Subcontractor.

10.2.6 The Contracting Authority and Owner do not represent that required coverage or limits are adequate to protect the Contractor.

10.2.7 Failure of the Contracting Authority to demand a certificate or other evidence of full compliance with the insurance requirements or failure of the Contracting Authority to identify a deficiency from evidence that is provided shall not be construed as a waiver of the Contractor's obligation to maintain the required insurance.

10.2.8 The Contracting Authority may terminate the Contract for cause on account of the Contractor's failure to maintain required insurance.

10.3 Contractor's Minimum Coverage Requirements

10.3.1 Workers Compensation. The Contractor shall maintain workers' compensation coverage meeting the requirements of Applicable Law including, without limitation, the Jones Act and the Longshore & Harbor Workers Compensation Act if Work involves hazards arising from work on or near navigable waterways, including vessels and docks.

10.3.2 Employers' Liability Coverage. The Contractor shall maintain employers' liability coverage with **(1)** an each-accident limit of not less than $1,000,000, **(2)** a disease each-employee limit of not less than $1,000,000, and **(3)** a disease policy limit of not less than $1,000,000.

10.3.3 Commercial General Liability. The Contractor shall maintain commercial general liability ("CGL") coverage that provides **(1)** an each-occurrence limit of not less than $1,000,000, **(2)** a general-aggregate limit of not less than $2,000,000, and **(3)** a products and completed-operations aggregate limit of not less than $2,000,000.

10.3.3.1 The CGL insurance shall be written on ISO occurrence form CG 00 01 04 13 or a substitute form, providing at least equivalent coverage for liability arising from premises, operations, independent contractors, products/completed-operations, personal and advertising injury, and liability assumed under an insured contract.

10.3.3.2 The Contractor shall include the State, Contracting Authority, Owner, and A/E as additional insureds under the CGL policy using ISO endorsement CG 20 10 07 04 and ISO endorsement CG 20 37 07 04 or a substitute form(s) providing equivalent coverage.

10.3.3.3 The CGL policy shall be endorsed using ISO endorsement CG 25 03 or a substitute form providing equivalent coverage to provide that the general aggregate limit applies separately to each of the insured's projects.

10.3.3.4 The CGL policy shall not exclude coverage for property damage to the Work arising out of the products/completed-operations hazard where a Subcontractor performed the damaged Work or the Work out of which the damage arises.

10.3.3.5 The CGL insurance shall not exclude coverage for property damage to electronic data.

10.3.3.6 The CGL insurance shall apply as primary and non-contributory insurance with respect to any other insurance or self-insurance programs that cover the additional insured(s).

10.3.3.7 The CGL policy shall not exclude coverage to the additional insured(s) for bodily injury or property damage arising out of the products/completed-operations hazard.

10.3.3.8 The Contractor shall maintain the CGL insurance in effect for no less than five years after the earlier of termination of the Contract or Substantial Completion of all Work.

10.3.4 Business Automobile Liability. The Contractor shall maintain business automobile ("BA") coverage written on ISO form CA 00 01 04 13 or a substitute form, providing at least equivalent coverage with a limit of not less than $1,000,000 each accident.

10.3.4.1 The coverage shall extend to any auto (owned, not owned, leased, rented, hired, or borrowed).

10.3.4.2 The Contractor shall include the State, Contracting Authority, Owner, and A/E as additional insureds under the BA policy.

10.3.4.3 The BA policy shall include an MCS-90 endorsement if transporting hazardous wastes/materials.

10.3.5 Umbrella/Excess Liability. The Contractor may employ an umbrella/excess liability policy to achieve the above-required minimum coverage.

10.3.5.1 The Contractor shall maintain umbrella/excess liability coverage with a limit of not less than $2,000,000 (in addition to the above-required limits) if the Work (or the Work to be performed by the Subcontractor) includes any of the following:

.1 brick/block masonry;
.2 exterior caulking/sealant;
.3 cast-in-place or precast concrete;
.4 curtain wall;
.5 dampproofing/waterproofing;
.6 electrical;
.7 elevator;
.8 exterior glass and/or glazing;
.9 exterior marble, granite, and/or other stonework;
.10 miscellaneous metals;

.11 plaster/stucco;

.12 plumbing;

.13 HVAC;

.14 roofing and/or sheet metal;

.15 scaffolding;

.16 spray-on fireproofing;

.17 sprinkler and/or fire protection; or

.18 structural steel and/or metal deck.

10.3.5.2 The Contractor shall maintain umbrella/excess liability coverage with a limit of not less than $5,000,000 (in addition to the above-required limits) if the Work (or the Work to performed by the Subcontractor) includes any of the following:

.1 caissons and/or piles;

.2 demolition;

.3 excavation and/or utility work;

.4 sheeting, shoring, and/or underpinning;

.5 window washing equipment; or

.6 wrecking.

10.3.6 Contractor's Pollution Liability. If the Work includes environmentally sensitive, hazardous types of activities (such as demolition, exterior insulation finish systems, Asbestos abatement, storage-tank removal, or similar activities), or involves Hazardous Materials, the Contractor shall maintain a contractor's pollution liability ("CPL") policy with **(1)** a per-claim limit of not less than $1,000,000 and **(2)** an annual-aggregate limit of not less than $1,000,000, covering the acts, errors and/or omissions of the Contractor for damages (including from mold) sustained by the Owner by reason of the Contractor's performance of the Work.

10.3.6.1 The CPL policy shall have an effective date, which is on or before the date that the Contractor first started to perform any Project-related services.

10.3.6.2 Upon submission of the associated certificate of insurance and at each policy renewal, the Contractor shall advise the Contracting Authority in writing of any actual or alleged claims that may erode the CPL policy's limits.

10.3.6.3 The Contractor shall maintain the CPL insurance in effect for no less than five years after the earlier of termination of the Contract or Substantial Completion of all Work.

10.3.7 Professional Liability—Contractor. The Contractor shall maintain contractor's professional liability ("PL") insurance (including without limitation for sprinkler and/or fire protection and other design-build work included in the Work, and services related to coordination and scheduling of construction activities, and means and methods) without design-build exclusions with limits not less than as identified in the following table:

Contract Sum	Each Claim	Annual Aggregate
Up to $50,000,000	$1,000,000	$2,000,000
More than $50,000,000	$2,000,000	$4,000,000

10.3.7.1 The PL policy shall have an effective date on or before the date that the Contractor first started to provide any Project-related services.

10.3.7.2 Upon submission of the associated certificate of insurance and at each policy renewal, the Contractor shall advise the Contracting Authority in writing of any actual or alleged claims that may erode the PL policy's limits.

10.3.7.3 The Contractor shall maintain the PL insurance in effect for no less than five years after the earlier of termination of the Contract or Substantial Completion of all Work.

10.3.7.4 If the Contractor is authorized under Applicable Law to directly provide professional design services, the Contractor may satisfy the requirements of this **Section 10.3.7** by providing a professional liability insurance policy.

10.3.7.5 If the Contractor is a joint venture:

.1 the Contractor may meet the requirements of this **Section 10.3.7** by providing a PL policy under which each joint venturer is the insured; or

.2 each joint venturer shall individually meet the requirements of this **Section 10.3.7** by providing a PL policy **(1)** under which the individual joint venturer is the insured and **(2)** that covers that joint venturer's interests

in the joint venture by endorsement or otherwise. The certificate of insurance shall reflect that the PL policy covers the joint venturer's interest in the joint venture.

Example: Assume that the Contractor **(1)** is the "XY joint venture" of company "X" and company "Y"; and **(2)** is required under **Section 10.3.7** to maintain PL insurance limits of $1M/$2M. In order to comply with **Section 10.3.7.5.2**, "X" must maintain PL insurance limits of $1M/$2M and "Y" must maintain PL insurance limits of $1M/$2M.

10.3.7.6 If the Contractor is a limited-liability company, which members consist of two or more separate firms:

.1 the Contractor may meet the requirements of this **Section 10.3.7** by providing a PL policy under which the limited-liability company is the insured; or

.2 each member of the limited-liability company shall individually meet the requirements of this **Section 10.3.7** by providing a PL policy **(1)** under which the individual member is the insured and **(2)** that covers that member's interests in the limited-liability company by endorsement or otherwise. The certificate of insurance shall reflect that the PL policy covers the member's interest in the limited-liability company.

Example: Assume that the Contractor **(1)** is the "XY limited-liability company," the members of which are "X" and "Y"; and **(2)** is required under **Section 10.3.7** to maintain PL insurance limits of $1M/$2M. In order to comply with **Section 10.3.7.6.2**, "X" must maintain PL insurance limits of $1M/$2M and "Y" must maintain PL insurance limits of $1M/$2M.

10.3.8 Professional Liability—Subcontractors. If the Work to be performed by a Subcontractor includes any professional design services (including without limitation sprinkler and/or fire protection and other design-build work) the Subcontractor shall maintain contractor's PL insurance without design-build exclusions with limits not less than as identified in the following table:

Subcontract Sum	Each Claim	Annual Aggregate
Up to $50,000,000	$1,000,000	$2,000,000
More than $50,000,000	$2,000,000	$4,000,000

10.3.8.1 The PL policy shall have an effective date on or before the date that the Subcontractor first started to provide any Project-related services.

10.3.8.2 Upon submission of the associated certificate of insurance and at each policy renewal, the Contractor shall advise the Contracting Authority in writing of any actual or alleged claims that may erode the Subcontractor's PL policy's limits.

10.3.8.3 The Subcontractor shall maintain the PL insurance in effect for no less than five years after the earlier of termination of the Contract or Substantial Completion of all Work.

10.3.8.4 If the Subcontractor is authorized under Applicable Law to directly provide professional design services, the Subcontractor may satisfy the requirements of this **Section 10.3.7.5** by providing a professional liability insurance policy.

10.3.9 Aviation Liability. If the Contractor or a Subcontractor uses manned or unmanned aircraft, including helicopters, in performance of the Work, the Contractor shall maintain aircraft or aviation liability coverage in an amount of no less than $10,000,000. The Contracting Authority and Owner will not be liable for any damage to any aircraft owned, leased, rented, or borrowed by the Contractor or a Subcontractor.

10.3.10 Watercraft Liability. If the Contractor or a Subcontractor uses watercraft in performance of the Work, the Contractor shall maintain watercraft liability coverage including protection and indemnity insurance in an amount of no less than $5,000,000. The Contracting Authority and Owner will not be liable for any damage to any watercraft owned, leased, rented, or borrowed by the Contractor or Subcontractor.

10.3.11 Equipment Coverage. The Contracting Authority and Owner will not insure or be liable for damage to any Contractor or Subcontractor owned, leased, rented, or borrowed tools, equipment, or vehicles. The Contractor and Subcontractors are solely responsible for maintaining all insurance necessary to cover their tools, equipment, and vehicles.

10.3.12 Ocean Marine Insurance. If the shipment of equipment or materials for the Work will not be covered by the builder's risk insurance described under **Section 10.4**, the Contractor shall maintain ocean marine insurance to the Site including cost, insurance, and freight with limits of not less than an amount equal to the full replacement cost of equipment/materials shipped to final destination point.

10.3.12.1 The insurance shall include the following minimum requirements:

.1 all-risk basis including war risk and all forms of terrorism;
.2 coverage for general average and salvage charges;
.3 "on deck" coverage;
.4 warehouse-to-warehouse coverage;
.5 coverage to include losses from strikes, riots, and civil commotions ("SR&CC coverage");
.6 coverage to include losses from free of capture and seizure warranty ("FC&S Warranty coverage");
.7 "Inchmaree" clause;
.8 sue and labor;
.9 "both-to-blame" coverage;
.10 free of particular average;
.11 inland coverage including on-land shipment, port storage, and barge transit upon inland waterways; and
.12 damage by saltwater and rainwater perils and cargo sweat.

10.3.13 Additional Property Insurance. For any demolition, blasting, excavating, tunneling, shoring, or similar operations, the Contractor shall provide and maintain Property Damage Liability insurance with a limit of liability equal to the limit as specified in the applicable sections of **Article 10**.

10.4 Builder's Risk Insurance

10.4.1 The Contractor shall maintain a builder's risk insurance policy written on a special causes of loss form and an open-perils basis providing coverage for direct physical loss of or damage to covered property arising from insured perils that shall not exclude: theft; fire; vandalism; malicious mischief; earthquake; earth movement; tornado; lightning; explosion; breakage of glass; flood; windstorm; collapse; water damage; hot and cold testing; debris removal and/or demolition occasioned by enforcement of Applicable Law; sudden and accidental equipment breakdown; and resulting damage from error, omission, or deficiency in construction methods, design, specifications, workmanship, or materials.

10.4.1.1 The policy shall cover the Project in the course of construction including false-work, temporary buildings and structures, and materials used in the construction process, stored on or off-site, or while in transit.

10.4.1.2 The coverage shall be written on a replacement-cost basis in an amount equal to not less than the initial Contract Sum, plus the value of: **(1)** all subsequent GMP Amendments and Modifications; **(2)** materials supplied and installed by others; and **(3)** any furnishings, fixtures, materials, or equipment located at the Site. All sub-limits of coverage are subject to the prior written approval of the Contracting Authority and Owner.

10.4.1.3 The policy shall not include any deductible of more than $25,000 per occurrence. Any deductible over that amount is subject to the prior written approval of the Contracting Authority and Owner.

10.4.1.4 The named insureds under the policy shall include the State, Contracting Authority, Owner, Contractor, Subcontractors at all tiers, and Separate Contractors.

10.4.1.5 Coverage shall include the reasonable extra costs of acceleration and expediting temporary and permanent repairs to, or permanent replacement of, damaged property. Those covered costs shall include overtime wages and the extra cost of "express" or other means for rapidly transporting materials and supplies necessary to the repair or replacement.

10.4.1.6 Coverage shall include a "soft cost endorsement" including, but not limited to, the reasonable extra costs of the A/E and reasonable Contractor extension or acceleration costs.

10.4.1.7 Coverage shall waive all rights between the Owner, Contracting Authority, Contractor, and Subcontractors at any tier, for damages caused by fire or any other perils to the extent of actual recovery of any insurance proceeds under the policy.

10.4.1.8 Coverage shall include provisions for mechanical or electrical breakdown, or boiler system testing if a boiler system is part of the Work.

10.4.1.9 Coverage shall include temporary structures and scaffolding, along with collapse coverage.

10.4.1.10 Coverage shall be primary to all other applicable insurance.

10.4.1.11 The policy shall specifically permit and allow for Partial Occupancy as defined under the Contract Documents and for partial occupancy or a similar term as used under the policy.

10.4.1.12 The Contractor shall maintain the policy in effect until Substantial Completion of all Work. The Contractor shall provide written notice to the Contracting Authority no less than 30 days before the expiration or termination of the policy.

10.4.1.13 The Contractor's tools and equipment shall not be covered under the builder's risk policy. It is the Contractor's sole responsibility to maintain such coverage, the cost of which shall be included in its Overhead (a component of Contractor's Fee) and not included as a separate item in the Contractor's Schedule of Values.

10.4.2 If the Contractor is involved solely in the installation of material and equipment and not in new building construction, the Contractor shall purchase and maintain a builder's risk, builder's risk-renovations, or installation floater insurance policy. The policy shall comply with the provisions of **Section 10.4.1.**

10.4.3 No less than ten days before the Contractor starts to perform any Work on the Site, the Contractor shall provide to the Contracting Authority an insurance-company certified copy of the complete insurance policy required under **Section 10.4.1** or **10.4.2** as applicable. The Contracting Authority's receipt of that copy of the policy is a condition precedent to the Contractor's entitlement to payment of any portion of the Contract Sum.

10.5 Waivers of Subrogation

10.5.1 To the fullest extent permitted by Applicable Law, the Contractor waives all rights against the Owner, Contracting Authority, and their agents and employees for damages to the extent covered by any insurance, except rights to the proceeds of that insurance. All policies shall accomplish the waiver of subrogation by endorsement or otherwise.

10.5.2 The Owner, Contracting Authority, and Contractor waive all rights against each other for damages caused by fire or other perils to the extent of actual recovery of any insurance proceeds under any property insurance, inland marine insurance, or builder's risk insurance applicable to the Work.

10.6 Indemnification for Injury or Damage

10.6.1 To the fullest extent permitted by Applicable Law, the Contractor shall indemnify, defend, and hold harmless the Indemnified Parties from and against all claims, costs, damages, losses, fines, penalties, and expenses (including but not limited to all fees and charges of attorneys and other professionals, and all court, arbitration, or other dispute-resolution costs) arising out of or in connection with the Project, provided that any such claim, cost, damage, loss, fine, penalty, or expense is attributable to:

10.6.1.1 bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property but only to the extent caused by the negligent acts, errors, or omissions of the Contractor or a person or entity for whom the Contractor may be liable;

10.6.1.2 infringement of patent rights or copyrights by the Contractor or a person or entity for whom the Contractor may be liable; or

10.6.1.3 a violation of Applicable Law but only to the extent attributable to the Contractor or a person or entity for whom the Contractor may be liable.

10.6.2 The Contractor's indemnification obligation under **Section 10.6** exists regardless of whether or not and the extent to which the claim, damage, loss, fine, penalty, or expense is caused in part by a party indemnified under **Section 10.6**. But nothing in **Section 10.6** obligates the Contractor to indemnify any individual or entity from and against the consequences of that individual or entity's own negligence.

10.6.3 The Contractor's obligations under **Section 10.6** shall not extend to the liability of the A/E, A/E's consultants, agents, representatives, or employees for negligent preparation or approval of Drawings, Specifications, Change Orders, opinions, and any other responsibility of the A/E, except to the extent covered by the Contractor's insurance.

10.6.4 In claims against an Indemnified Party by any direct or indirect employee (or the survivor or personal representative of that employee) of the Contractor or a person or entity for whom the Contractor may be liable, the indemnification obligation under **Section 10.6** will not be limited by a limitation on the amount or type of damages, compensation, or benefits payable under workers' compensation acts, disability benefit acts, or other employee benefit acts.

10.6.5 The Contractor's indemnification obligation under **Section 10.6** will not be limited by any insurance policy provided or required in connection with the Project.

10.6.6 The Contractor's obligations under **Section 10.6** shall not negate, abridge, or reduce other rights or obligations of indemnity, which would otherwise exist as to an Indemnified Party.

10.6.7 The Contractor's indemnification obligation under **Section 10.6** will survive termination of the Contract and Contract Completion.

10.6.8 The Contracting Authority may deduct from the Contract Sum the claims, damages, losses, fines, penalties, and expenses for which the Contractor is liable under **Section 10.6**. If those claims, damages, losses, fines, penalties, and expenses exceed the unpaid balance of the Contract Sum, the Contractor shall immediately pay the difference to the Owner.

ARTICLE 11 - SUSPENSION AND TERMINATION

11.1 Suspension of the Work

11.1.1 The Contracting Authority, without cause and without prejudice to any other right or remedy it may have, may order the Contractor in writing to suspend, delay, or interrupt performance of the Work in whole or in part for such period as the Contracting Authority may determine.

11.1.1.1 If the Contracting Authority suspends the Work under this **Section 11.1.1** and the Contractor complies with **Article 7** and **Article 8**, the Contract Sum and Contract Times shall be adjusted for increases in the cost and time caused by the suspension, delay, or interruption.

11.1.1.2 Notwithstanding the foregoing, no adjustment shall be made to the Contract Sum or Contract Times to the extent that:

.1 performance was or could have been suspended, delayed, or interrupted by a cause for which the Contractor is responsible; or

.2 an equitable adjustment is made or denied under another provision of the Contract.

11.1.1.3 If the Contracting Authority suspends the Work under this **Section 11.1.1** and the Contractor submits a proper Contractor Payment Request, subject to all other provisions of the Contract Documents, the Contractor shall be entitled to payment of compensation due under the Contract Documents for Work performed before the suspension based upon the Schedule of Values.

11.1.2 The Contracting Authority, without prejudice to any other right or remedy it may have, may order the Contractor in writing to suspend, delay, or interrupt the performance of the Work in whole or in part for such period as the Contracting Authority may determine for any of the following reasons: **(1)** Defective Work; **(2)** the Contractor is causing undue risk of damage to any part of the Project or adjacent area; **(3)** the Contractor fails to furnish or perform the Work in such a way that the complete Work will conform to the requirements of the Contract Documents; or **(4)** any other cause the Contracting Authority reasonably believes justifies suspension.

11.1.2.1 The Contracting Authority's exercise of its right to suspend the Work under this **Section 11.1.2** shall not entitle the Contractor to any adjustment of the Contract Sum, Contract Times, or both.

11.1.2.2 If the Contracting Authority is adjudged to have improperly or unjustifiably suspended the Work under this **Section 11.1.2**, the suspension shall be deemed to have been a suspension under **Section 11.1.1**.

11.1.3 Upon receipt of notice of suspension under this **Section 11.1**, the Contractor shall cease Work on the suspended activities and take all necessary or appropriate steps to limit disbursements and minimize respective costs. The Contractor shall furnish a report to the Contracting Authority, within five days after receiving the notice of suspension, describing the status of the Work, including, but not limited to, results accomplished, resulting conclusions, and other information as the Contracting Authority may require.

11.1.4 The Contracting Authority's right to stop the Work shall not give rise to any duty to exercise the right for the benefit of the Contractor or any other party, and the Contracting Authority's exercise or failure to exercise the right shall not prejudice any of the Contracting Authority's other rights.

11.2 Termination for Convenience

11.2.1 The Contracting Authority may at any time terminate the Contract in whole or in part for the Owner's convenience and without cause, upon written notice to the Contractor.

11.2.2 Upon receipt of the notice of termination for convenience, the Contractor shall immediately proceed with performance of the following duties in accordance with instructions from the Contracting Authority:

11.2.2.1 cease operation as specified in the notice;

11.2.2.2 proceed as described under **Section 11.3.4;** ;

11.2.2.3 proceed with Work not terminated; and

11.2.2.4 take actions that may be necessary, or that the Contracting Authority may direct, for the protection and preservation of the terminated Work.

11.2.3 After terminating the Contract for convenience, the Owner shall pay the Contractor in accordance with the Schedule of Values for Work completed, including Contractor's Fee, any retained funds, and the value of materials ordered and delivered, less any salvage credit the Contractor may receive for them.

11.2.3.1 All materials, equipment, facilities, and supplies at the Site or stored off-site, for which the Contractor has received payment, shall become the property of the Owner.

11.2.3.2 In no event shall the Contractor be entitled to **(1)** Contractor's Fee on or any other compensation for Work not performed or **(2)** compensation in excess of the total Contract Sum.

11.2.4 If the Contracting Authority terminates the Work under this **Section 11.2**, the termination shall not affect the rights or remedies of the State against the Contractor then existing or which may thereafter accrue.

11.2.5 Notwithstanding **Section 11.2.3**, if the Contracting Authority terminates the Work under this **Section 11.2**, but there exists an event of the Contractor's default, the Contractor shall be entitled to receive only such amounts as it would be entitled to receive following the occurrence of an event of default as provided in **Section 11.3**.

11.3 Termination for Cause

11.3.1 The Contracting Authority may terminate the Contract in whole or in part if the Contractor commits a material breach of the Contract including but not limited to:

11.3.1.1 failure to prosecute the Work with the necessary force or in a timely manner;

11.3.1.2 refusal to remedy Defective Work;

11.3.1.3 failure to supply enough properly skilled workers or proper materials;

11.3.1.4 failure to properly make payment to Subcontractors or Consultants;

11.3.1.5 performance of any services outside of the United States;

11.3.1.6 permitting its Subcontractors or Consultants to perform any services outside of the United States; or

11.3.1.7 disregarding laws, ordinances, rules, regulations, or orders of a public authority with jurisdiction over the Project.

11.3.2 If the Contracting Authority intends to exercise its termination rights under this **Section 11.3**, the Contracting Authority shall issue not less than five days' written notice to the Contractor and the Contractor's Surety in accordance with ORC Section 153.17 ("Five-Day Notice").

11.3.2.1 Notwithstanding any provision of the Contract to the contrary **(1)** the issuance of a 72-Hour Notice under **Section 6.24.1** is not a condition precedent to the Contracting Authority's exercise of its rights under **Section 11.3** and **(2)** the Contracting Authority's decision to not issue a 72-Hour Notice under **Section 6.24.1** will not prejudice the Contracting Authority's rights under **Section 11.3**.

11.3.3 If the Contractor fails to satisfy the requirements set forth in the Five-Day Notice within 15 days after receipt of the Five-Day Notice, the Contracting Authority may declare the Contractor in default, terminate the Contract, and employ upon the Work the additional force or supply materials or either as appropriate, and remove Defective Work.

11.3.4 After termination, the Contractor shall to the extent related to the performance of the discontinued portion of the Work, unless the notice of termination directs otherwise:

11.3.4.1 immediately discontinue the Work on that date, place no further orders or Subcontracts for materials, equipment, services, facilities, or otherwise, except as may be necessary for completion of such portion of the Work as is not discontinued;

11.3.4.2 subject to the Contracting Authority's exercise of its rights under **Section 4.5**, promptly make every effort to procure cancellation upon terms satisfactory to the Contracting Authority of all Subcontracts;

11.3.4.3 promptly work with the Contracting Authority in good-faith to develop and implement plans to **(1)** secure the Site and off-Site stored materials; **(2)** inventory and verify **(a)** the location and quantity of materials stored on and off-Site and **(b)** the status of the progress of the Work; and **(3)** identify all Project-related permits;

11.3.4.4 no less than five days after the effective date of the termination, deliver to the Contracting Authority all Contractor-maintained, Project-related permits;

11.3.4.5 no less than seven days after the effective date of the termination, deliver to the Contracting Authority the following information and documents concerning each Subcontractor: **(1)** name and address; **(2)** name, address, telephone number, and email address of the Subcontractor's primary point of contact for the Project; **(3)** scope of the Subcontract Work (including equipment supplied); **(4)** a complete and unredacted copy of the Subcontract(s); **(5)**

complete and unredacted copies of all Subcontract modifications (e.g., change orders, amendments, etc.) and related documents; **(6)** complete and unredacted copies of all pending claims, requests for additional compensation, requests for additional time, unexecuted change orders, and related documents; **(7)** complete and unredacted copies of all pay applications (paid and pending); **(8)** a complete and unredacted copy of the Contractor's accounts-payable report for the Subcontractor; **(9)** complete and unredacted copies of any non-conforming Work reports/notices and related documents; and **(10)** complete and unredacted copies of any surety bond(s) or other performance security provided by the Subcontractor.

11.3.4.6 no less than 21 days after the effective date of the termination, pay all undisputed amounts due to each Subcontractor for Work performed before the effective date of termination and deliver to the Contracting Authority lien waivers to evidence those payments; and

11.3.4.7 do only such Work as may be necessary to protect the Work already in progress and to protect materials and equipment on the Project Site or in transit thereto.

11.3.5 If the Contract is terminated, the Contractor's Surety may perform the Contract. If the Contractor's Surety does not commence performance of the Contract within ten days after the date of Contract termination, the Contracting Authority may complete the Work by any means the Contracting Authority determines appropriate. The Contracting Authority may take possession of and use all materials, facilities, and equipment at the Site or stored off-site, for which the Owner has paid.

11.3.6 If the Contract is terminated, the Contractor shall not be entitled to further payment. If the unpaid balance of the Contract Sum is exceeded by the costs of finishing the Work, including without limitation the fees and charges of engineers, architects, attorneys, and other professionals and court costs, and other damages incurred by the Owner and not expressly waived, the Contractor or Surety shall immediately pay the amount of the insufficiency to the Owner. This obligation for payment shall survive termination of the Contract.

11.3.7 If the Contractor's Surety performs the Work, the provisions of the Contract Documents govern the Surety's performance, with the Surety in place of the Contractor in all provisions including, but not limited to, provisions for payment for the Work, and provisions of the right of the Contracting Authority to complete the Work.

11.3.8 If the Contracting Authority terminates the Contract under this **Section 11.3**, the termination shall not affect any rights or remedies of the State against the Contractor then existing or which may thereafter accrue. The Contracting Authority's retention or payment of funds due the Contractor shall not release the Contractor or the Contractor's Surety from liability for performance of the Work in accordance with the requirements of the Contract Documents.

11.3.9 If the Contracting Authority is adjudged to have improperly or unjustifiably terminated the Contract under this **Section 11.3**, the termination will be deemed to have been a termination under **Section 11.2**.

11.4 Contractor Insolvency

11.4.1 The Contracting Authority may immediately terminate the Contract for cause if:

11.4.1.1 the Contractor commences a voluntary case under Title 11 of the United States Code or the corresponding provisions of any successor laws; or

11.4.1.2 any legal entity commences an involuntary case against the Contractor under Title 11 of the United States Code or the corresponding provisions of any successor laws and **(1)** the case is not dismissed within 60 days after its commencement; or **(2)** the court before which the case is pending issues an order for relief or similar order approving the case; or

11.4.1.3 a court of competent jurisdiction appoints, or the Contractor makes an assignment of all or substantially all of its assets to, a receiver, trustee, liquidator, or other similar custodian for the Contractor or all or substantially all of the Contractor's assets; or

11.4.1.4 any attachment, execution, or other judicial seizure is levied against all or substantially all of the Contractor's assets; or

11.4.1.5 the Contractor takes any action toward the dissolution or winding up of its business; or

11.4.1.6 the Contractor fails generally to pay its debts as they become due (unless those debts are subject to a good-faith dispute as to liability or amount) or it acknowledges in writing that it is unable to do so.

11.4.2 If the Contractor files a voluntary petition in bankruptcy or has an involuntary petition in bankruptcy filed against it, the Contractor, the Contractor as the debtor-in-possession, or the trustee of the Contractor's bankruptcy estate shall file a motion to assume or reject the Contract under Bankruptcy Code § 365, 11 U.S.C. § 365, within 20 days after the

filing of the voluntary petition or involuntary petition and shall diligently prosecute that motion to conclusion so as to obtain an order granting or denying that motion within 45 days after the filing of the voluntary or involuntary petition.

11.4.3 If the Contracting Authority intends to exercise its termination rights under this **Section 11.4**, the Contracting Authority shall notify the Contractor in writing of the Contracting Authority's termination of the Contract and the cause(s) for that termination.

11.4.4 The Contractor agrees to the granting of relief from the automatic stay of the Bankruptcy Code, 11 U.S.C. § 362(a), to permit the Contracting Authority to terminate the Contract for cause in such instance and issue and serve all notices necessary to terminate the Contract or arising out of the termination of the Contract and to take any and all other action necessary to terminate the Contract.

ARTICLE 12 - GENERAL PROVISIONS

12.1 Contractor's Documents and Contract Documents

12.1.1 Ownership.

12.1.1.1 The Owner alone owns the Contractor's Documents and the Contract Documents and every right, title, and interest therein.

.1 The Contractor shall execute and deliver and cause its employees and agents and all Subcontractors and Consultants to execute and deliver to the Owner any transfers, assignments, documents, or other instruments (if any) necessary to vest in the Owner complete right, title, interest in and ownership of the Contractor's Documents and the Contract Documents.

12.1.1.2 The Contractor may retain copies, including reproducible copies, of the Contractor's Documents and the Contract Documents for information, reference, and performance of the Work.

12.1.1.3 The submission or distribution of the Contractor's Documents or the Contract Documents to meet official regulatory requirements or for similar purposes in connection with the Project is not a waiver of the Owner's reserved rights in the Contractor's Documents and the Contract Documents. Any unauthorized use of the Contractor's Documents or the Contract Documents shall be at the sole risk of the entity making the unauthorized use.

12.1.1.4 The Contractor shall provide Electronic Files of the Contractor's Documents to Separate Consultants and Separate Contractors for their use in connection with the Project. The Contractor shall provide the Electronic Files **(1)** at no additional cost to the Separate Consultants, Separate Contractors, and Owner and **(2)** without requiring the Separate Consultants, Separate Contractors, or Owner to agree to any terms or conditions concerning the provision, receipt, or use of the Electronic Files that differ in any material respect from the Contract.

12.1.2 Intent.

12.1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor.

12.1.2.2 The Contract Documents are complementary, and what is required by one is binding as if required by all.

12.1.2.3 The Contractor shall provide all labor and materials necessary for the entire completion of the Work described in the Contract Documents and reasonably inferable to produce the intended results.

12.1.2.4 The Drawings govern dimensions, details, and locations of the Work. The Specifications govern quality of materials and workmanship.

12.1.2.5 The organization of the Specifications in divisions, sections, and articles, and the arrangement of Drawings shall not restrict the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

12.1.2.6 In the event of inconsistency or conflict within the Contract Documents, the Contractor shall provide the better quality or greater quantity of Work, and comply with the stricter requirement.

12.1.2.7 Unless otherwise defined in the Contract Documents, words that have well-known technical or construction industry meanings are used in accordance with those recognized meanings.

12.1.2.8 The Sections of Division 01 - "General Requirements" govern the performance of the Work of all Sections of the Specifications.

12.1.3 Use of Electronic Files.

12.1.3.1 The Owner, Contracting Authority, A/E, and Contractor reasonably expect that they will provide Electronic Files to each other to facilitate the design and construction of the Project consistent with current practices and customs in the construction industry.

12.1.3.2 The Owner, Contracting Authority, A/E, and Contractor acknowledge that the use of Electronic Files involves risks not generally associated with the use of paper documents. Those risks include, for example and without limitation, alteration (inadvertent or intentional) and deterioration, both of which may not be readily apparent through casual observation.

12.1.3.3 The Owner, Contracting Authority, A/E, and Contractor do not warrant to each other that any Electronic File they provide **(1)** was not altered through transmission; **(2)** is compatible with the recipient's computer system or software; **(3)** will not be altered through degradation of the recipient's storage media; or **(4)** is suitable for conversion/translation to and subsequent use in a system or format other than the Electronic File's original system or format.

12.1.3.4 Before relying on any Electronic File it receives, the recipient is responsible for verifying that the Electronic File was not altered through transmission, degradation of the recipient's own storage media, or other causes.

12.1.3.5 If the recipient of an Electronic File converts/translates the Electronic File from its original system or format to an alternate system or format, the recipient assumes the risk that the conversion/translation created errors in the converted/translated file.

12.1.3.6 The Owner, Contracting Authority, A/E, and Contractor shall each maintain and operate its own computer systems and storage media in a commercially reasonable way and take reasonable steps to prevent errors in and deterioration of the Electronic Files it creates, provides, and receives.

12.1.3.7 In the event of a discrepancy between information contained in a paper version of a document and the Electronic File of that document, the paper version will govern.

12.1.3.8 This **Section 12.1.3** does not relieve the Contractor of its responsibility for the preparation, completeness, or accuracy of the Contractor's Documents.

12.2 Public Relations

12.2.1 Publicity prior to completion of the Project. Prior to completion of the Project, public relations or publicity about the Project shall be solely within the control, and with the consent of, the Owner.

12.2.2 Publicity after completion of the Project. After completion of the Project, the Contractor may exercise reasonable public relations and marketing efforts related to the Project, provided the Contractor properly identifies the Owner and Contracting Authority, and their participation in the Project.

12.2.3 Professional Photography. If the Contractor commissions photography of the completed Project, the Contractor shall include in its photography agreements a release for unrestricted and unlimited use of photographs by the Owner and Contracting Authority, and shall provide the Owner and Contracting Authority with a reasonable quantity of photographs for use in the Owner's and the Contracting Authority's marketing and awareness activities, including, but not limited to, profiles of the Project on their respective websites.

12.2.4 Craft Awards and Other Recognition. If the Contractor submits the Project for craft awards or other similar venues for recognition of the Project, the Contractor shall properly identify the Owner and Contracting Authority, and their participation in the Project. In addition, if the Project receives any craft award or other recognition, the Contractor shall provide duplicate copies of the award plaque or other memento of the award to the Owner and Contracting Authority.

12.3 Application and Governing Law

12.3.1 The Contract and the rights of the parties thereunder shall be governed by the laws of the state of Ohio and only Ohio courts shall have jurisdiction over any action or proceeding concerning the Contract and/or performance thereunder. The Contractor irrevocably consents to such jurisdiction.

12.3.2 The parties to the Contract shall comply with Applicable Law.

12.3.3 Other rights and responsibilities of the Contractor, A/E, Contracting Authority, and Owner are set forth throughout the Contract Documents and included under different titles, articles, and paragraphs for convenience.

12.4 Conditions of the Contract

12.4.1 These General Conditions govern, take precedence over, and shall not be superseded or amended by Drawings and Specifications, unless so provided in Supplementary Conditions prepared by the Contracting Authority and approved by the Ohio Facilities Construction Commission.

12.5 Notice of Commencement.

12.5.1 The Contracting Authority shall prepare a Notice of Commencement and make it available as required under ORC Section 1311.252.

12.5.2 Upon request, the Contracting Authority or the Contractor shall furnish the Notice of Commencement to Subcontractors or any other member of the public.

12.6 Written Notice

12.6.1 Notice under the Contract Documents shall be validly given if:

12.6.1.1 delivered personally to a member of the organization for whom the notice is intended;

12.6.1.2 delivered by trackable delivery service, or sent by registered or certified mail, to the last known business address of the organization; or

12.6.1.3 delivered by facsimile, email, or project management software.

12.6.2 When the Owner, Contracting Authority, A/E, or Contractor gives notice to one of the other three, it shall also simultaneously send a copy of that notice to the others.

12.6.3 A copy of all notices, certificates, requests, or other communications to the Contracting Authority shall be sent to the Project Manager.

12.6.4 In the event of an emergency involving the Project, including, but not limited to, a fatality, serious injury, fire, collapse, flood, utility, or power loss to occupied facilities, explosion, or environmental damage, the Contractor shall immediately notify the A/E, Contracting Authority, and Owner by the most expedient means available.

12.6.5 The Contracting Authority, Owner, A/E, or Contractor may, by written notice given hereunder, designate addresses, telephone numbers, email addresses, or facsimile numbers to which notices, certificates, requests, or communications shall be sent.

12.7 Taxes

12.7.1 Only those materials that ultimately become a part of the completed structure or improvement that constitutes the Project shall be exempt from state sales tax and state use tax.

12.7.2 The purchase, lease, or rental of material, equipment, parts, or expendable items as concrete form lumber, tools, oils, greases, and fuels, which are used in connection with the Work, are subject to the application of state sales tax and state use tax.

12.8 Computing Time

12.8.1 When the Contract Documents refer to a period of time by a number of days, the period shall be computed to exclude the first and include the last day of the period. If the last day of the period falls on a Saturday, Sunday, or a Legal Holiday, that day shall be omitted from the computation and the period shall end on the next succeeding day that is not a Saturday, Sunday, or Legal Holiday.

12.8.2 Except as excluded under **Section 12.8.1**, the Contract Times and all other periods referred to in the Contract Documents includes Saturdays, Sundays, and all days defined as Legal Holidays in the Contracting Definitions.

12.8.3 The standard workdays for State projects are Monday through Friday, excluding Legal Holidays.

12.9 Time of the Essence

12.9.1 Time limits stated in the Contract Documents are of the essence of the Contract and all obligations under the Contract. By signing the Agreement, the Contractor acknowledges that the Contract Times are reasonable, taking into consideration the usual weather and other conditions prevailing in the locality of the Project. By signing the Construction Schedule, the Contractor acknowledges that the specified Milestone dates are reasonable, taking into consideration the usual weather and other conditions prevailing in the locality of the Project.

12.9.1.1 The Contractor acknowledges that the Owner has entered into, or may enter into, agreements for use of all or part of the premises where the Work is to be completed based upon the Contractor achieving Substantial Completion within the associated Contract Time.

12.9.1.2 The Contractor shall perform the Work in a reasonable, efficient, and economical sequence, and in the order and time as provided in the Construction Progress Schedule.

12.9.1.3 The Contractor acknowledges that it may be subject to interference, disruption, hindrance, or delay in the progress of the Work from any cause.

12.10 Successors and Assigns

12.10.1 The Contracting Authority and Contractor each bind themselves, their successors, assigns, and legal representatives, to the other party to this Contract and to the successors, assigns, and legal representatives of the other party with respect to all terms of this Contract.

12.10.2 The Contracting Authority and Contractor each acknowledge that the Owner is an intended third-party beneficiary of this Contract.

12.10.3 The Contractor shall not assign or transfer any right, title, or interest in this Contract without the Contracting Authority's prior written consent.

12.11 Extent of Contract

12.11.1 Entire Contract. Contract Documents represent the entire and integrated agreement between the Contracting Authority and Contractor and supersede all prior negotiations, representations, or agreements, either written or oral.

12.11.2 Multiple Counterparts. This Contract may be executed in any number of counterparts, each of which shall be regarded as an original and all of which shall constitute but one and the same instrument.

12.11.3 Captions. The captions and headings in this Contract are for convenience only and in no way define, limit, or describe the scope or intent of any provisions or sections hereof.

12.11.4 Precedence. In the event of a conflict or inconsistency between these General Conditions and any other Contract Documents (except Supplementary General Conditions), these General Conditions take precedence. In the event of a conflict or inconsistency between these General Conditions and Supplementary Conditions, the Supplementary Conditions take precedence.

12.12 Severability

12.12.1 If any term or provision of this Contract or the application thereof to any Person or circumstance, is finally determined to be invalid or unenforceable by a court of competent jurisdiction, the remainder of this Contract or the application of such term or provision to other Persons or circumstances, shall not be affected thereby, and each term and provision of this Contract shall be valid and enforced to the fullest extent permitted by Applicable Law.

12.13 Electronic and Facsimile Signatures

12.13.1 Any party hereto may deliver a copy of its counterpart signature page to this Contract via electronic signature software, fax, e-mail, or project management software. Each party hereto shall be entitled to rely upon an electronic, scanned, or facsimile signature of any other party delivered in such a manner as if such signature were an original.

12.14 No Third-Party Interest

12.14.1 Except as expressly provided under **Sections 6.2.2** through **6.2.5** and **Section 12.10.2**, **(1)** no person or entity, other than the Contracting Authority, Owner, and Contractor, will have any right or interest under the Contract, and **(2)** the Contract does not create a contractual relationship of any kind between any people or entities other than the Contracting Authority, Owner, and Contractor.

12.15 Ohio Retirement System

12.15.1 All individuals employed by the Contractor that provide personal services to the Contracting Authority or Owner are not public employees for the purposes of ORC Chapter 145, as amended.

12.15.2 If the Contractor is a PERS retirant, as defined by ORC Section 145.38, the Contractor shall notify the Contracting Authority of such status in writing prior to commencement of Work. The Contracting Authority, Owner, or State is not responsible for changes to the Contractor's retirement benefits resulting from entering into this Contract.

12.16 No Waiver

12.16.1 The failure of the Contracting Authority or Contractor to insist in any one or more instances upon the strict performance of any one or more of the provisions of the Contract or to exercise any rights under the Contract or provided by law will not be construed as a waiver or relinquishment of that provision or right or of the right to subsequently demand strict performance or exercise the right and the rights will continue unchanged and remain in full force and effect.

12.17 Rights and Remedies

12.17.1 The duties, obligations, rights, and remedies under the Contract are in addition to and not a limitation of the duties, obligations, rights, and remedies otherwise imposed by or available under Applicable Law.

12.18 Survival of Obligations

12.18.1 All representations, indemnity obligations, warranties, guarantees, and necessarily continuing obligations under the Contract, will survive final payment, completion and acceptance of the Work, and termination or completion of the Contract.

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END OF DOCUMENT

Document 00 73 00 - Supplementary Conditions (WSU General Contracting)
State of Ohio Standard Requirements for Public Facility Construction

Certifications

These Supplementary Conditions amend and supplement the General Conditions and other provisions of the Contract Documents as indicated below. All provisions not amended remain in full force and effect. The terms in these Supplementary Conditions defined in the Contracting Definitions or the General Conditions shall have the meanings assigned to them in those documents.

These Supplementary Conditions are authorized, by the Ohio Facilities Construction Commission, for use on projects constructed by and for Wright State University ("University").

Contracting Authority

Wright State University
Engineering & Construction
3640 Colonel Glenn Highway
Dayton, Ohio 45435-0001
937.775.4140
http://www.wright.edu

Institutional Designee

Daniel Papay, P.E.
University Engineer

MODIFICATIONS TO GENERAL CONDITIONS

Insert Section 1.1.4 as follows:

1.1.4 This contractor and all subsequent subcontractors shall abide by the requirements of 41 CFR §§ 60-1.4(a), 60-300.5(a) and 60-741.5(a). These regulations prohibit discrimination against qualified individuals based on their status as protected veterans or individuals with disabilities, and prohibit discrimination against all individuals based on their race, color, religion, sex, or national origin. Moreover, these regulations require that covered prime contractors and subcontractors take affirmative action to employ and advance in employment individuals without regard to race, color, religion, sex, national origin, protected veteran status or disability.

Insert Section 1.10.3 as follows:

1.10.3 The Contractor shall provide the A/E and the University with a list of contact persons, with telephone numbers, for 24-hour emergency contact.

REFER TO LAST PAGE FOR ADDED SECTION 1.13.2

Insert Sections 6.3.4.2 through 6.3.4.5 as follows:

6.3.4.2 The Contractor is responsible for contacting the University Engineering & Construction Department at construction@wright.edu to obtain a dig permit 72 hours in advance of any digging, excavation, trenching, drilling, driving posts or any other such work. The University's Excavation/Boring Permit shall be made a part of this document and can be obtained at http://www.wright.edu.

6.3.4.3 The Contractor shall physically locate underground utilities installed or exposed by the Contractor prior to backfilling. Physically locating means to measure each change in direction from two separate permanent objects and note the depth below grade on the As-Built Documents.

6.3.4.4 In conjunction with **Section 6.3.4.1**, the Contractor shall document the location of any existing or new utility or device uncovered or installed underground in accordance with **Section 6.3.4.3**. This information is to be timely provided to the Project Manager for incorporation into the University's utility drawings.

6.3.4.5 The Contractor shall backfill excavations with material specified and approved in writing by the A/E. Surfaces (pavement, concrete, turf, etc.) shall be restored to like new conditions. Turf replacement shall be sod and not seed, unless otherwise approved by the University.

Insert Section 6.10.5.1.1 as follows:

.1 Work performed in an area that must be kept in operation shall be protected with a sheeted bulkhead sufficient to keep out dust and dirt, and to isolate the area.

Insert Section 6.10.5.2.1 as follows:

.1 The Contractor shall control fumes and dust to prevent any harmful or undesirable effects in the surrounding areas.

Insert Sections 6.10.6 through 6.10.10 as follows:

6.10.6 The Contractor, in coordination with the Project Manager, shall document the Site with a video recorder or other electronic means prior to the start of any Work on the Project. The video recording shall be made approximately 1 week prior to the start of construction. The purpose of the video recording will be to establish existing conditions before the Site is turned over to the Contractor. The video recording shall include, but is not limited to, lay-down/staging areas, condition of existing structures to remain, landscaping that is to remain or be restored subsequent to Project completion, any University property immediately adjacent to the Site, and ingress and egress routes across University property. The Contractor shall provide 1 copy of the video recording on a DVD-R disc to the Project Manager.

6.10.7 Temporary fencing shall be installed and maintained to protect the Site, including any lay-down areas, temporary offices, etc. The Contractor shall submit a fencing plan to the University prior to installation of any temporary fencing. The Contractor shall furnish and install chain link fencing, knuckled top and bottom, 6 feet high supported with minimum 1-5/8 inch line posts and 2-3/8 inch end/gate posts on 2 x 1 feet weighted bases a maximum of 10 feet on center. Mesh openings shall be a maximum of 2-3/8 inches. All fencing materials shall be galvanized. The University may require Knox locks be installed on entrance gates. Warning signs shall be posted on the fence 40 feet apart stating; “Construction Area-Keep Out” or similar verbiage approved in writing by the University.

6.10.8 The Contractor shall completely enclose the Site using temporary fencing under **Section 6.10.7**.

6.10.9 The Contractor shall ensure that the Site be secure from casual non-construction traffic (vehicular and pedestrian) from either entering in, or passing through, the Site and that the Site includes effective securing of equipment, storage of materials, and adequate lighting.

6.10.10 If the Contractor desires guard service, the Contractor may provide guard service at the Contractor's cost.

Replace Sections 6.13.4.1 and 6.13.4.2 with the following:

6.13.4.1 The Contractor shall notify the Project Manager 24 hours before the start of non-routine or non-recurring hot-work. Use of sources of fire, flame or sparks and flammable materials shall be kept to an absolute minimum. The Contractor shall take proper precautions to prevent fires when welding or while other fire-hazardous work is being performed. At the beginning of the Project, the Contractor shall inform the Project Manager of its intent to use blowtorches, welding apparatus, or similar exposed flame and sparking devices. Similar notice shall be given in regard to the use of flammable liquids, adhesives, and cleaners.

6.13.4.2 The Contractor shall furnish temporary fire extinguishers as required by Applicable Law (minimum of 1), which shall be within the immediate areas where work is being done at all times. The extinguishers shall be adequate and suitable for the class of fire likely to be caused by the Contractor’s operations.

Insert Sections 6.13.4.3 through 6.13.4.5 as follows:

6.13.4.3 The Contractor shall implement and follow practices designed to minimize risk and avoid harmful exposure to chemicals, biological or radiological substances, and physical or mechanical hazards.

6.13.4.4 The Contractor shall use facilities and equipment in the prescribed manner to avoid injury and health damage to themselves, others, and the environment.

6.13.4.5 The Contractor shall submit a written lockout/tag out procedure based on OSHA requirements to the University for approval at the beginning of the Project. The Contractor shall use the approved procedure whenever a system is to be de-energized.

Insert Sections 6.13.5.2.1 and 6.13.5.2.2 as follows:

.1 The licensed abatement contractor will make arrangements for the proper disposal of Hazardous Materials off-site according to Applicable Law and University regulations.

.2 University trash receptacles, sanitary sewers, and storm drains shall not be used for the disposal of Hazardous Materials.

Insert Section 6.14.1.3 as follows:

6.14.1.3 The Contractor shall comply with requirements of Applicable Law during installation, use, and removal of temporary controls, facilities, and utilities.

Insert Section 6.14.3.7 as follows:

6.14.3.7 The requirements of this **Section 6.14.3** shall include testing or bacteriological analysis required for new domestic water piping per the American Water Works Standard C651. The Contractor shall be responsible for sampling and bacteriological analysis required in existing piping and/or buildings taken out of service related to this

Project. Boil advisory situations and the University's policy regarding water shutdowns can be found in the University's Community Water System Contingency Plan (copies available upon request).

Insert Sections 6.14.4.1.1 and 6.14.4.1.2 as follows:

.1 A minimum of 10 foot-candles of night safety lighting covering the entire Site shall be provided for building construction (ANSI Standard 11.1-1973, Practice for Industrial Lighting).

.2 Lighting removed by the Contractor during construction shall be replaced with adequate temporary lighting during construction as determined by the A/E and/or the University.

Insert Section 6.15.4.2 as follows:

6.15.4.2 University trash receptacles, sanitary sewers, and storm drains shall not be used for the disposal of construction debris, waste materials, or rubbish.

Insert Section 6.15.5.3 as follows:

6.15.5.3 The Contractor shall maintain public streets and roads adjacent to property utilized for construction traffic clear, clean, and free from dirt and debris. Failure to clean public streets and roads will result in the University having it done at the expense of the Contractor in accordance with **Section 6.15.5.1**.

Insert Sections 6.16.7 through 6.16.12 and subordinate sections as follows:

6.16.7 Parking.

6.16.7.1 Main Campus. All parking on the University's Main Campus is restricted and controlled by the University's Parking & Transportation Department. Employees of contractors and subcontractors shall purchase parking permits from the Parking & Transportation Department and shall park cars in areas assigned to them. Contractors parking on University property will be charged the current rate to park, as space is available. Parking on streets or in restricted areas is prohibited. Violations will result in a citation or vehicle impoundment/ towing by a third party towing company. At the beginning of the Work, each contractor shall report to the Parking & Transportation Department the approximate number of parking permits which will be required for all employees, including employees of its subcontractors. On-site parking for all contractor personnel will not be permitted within construction limits.

6.16.7.2 All Other Campuses. Contractors performing Work on all other campuses shall coordinate with the Project Manager on matters of parking permits and designated areas.

6.16.8 The Contractor shall validate with the appropriate University, City, County, or State agency as to the status of road work impacting traffic flow on, to, and from, campus.

6.16.8.1 The Contractor shall not be permitted to use University streets for any purpose not previously approved by the Parking & Transportation Department. This includes, but is not limited to, trucks stopping on streets awaiting access to the Site. Should Site constraints be such that offloading of trucks from University streets is required, the Contractor shall provide a written request to the Parking & Transportation Department 5 days in advance of the date when the unloading is required. The Contractor shall pay for any traffic control occasioned by the street blockage. The Contractor shall also post signs three days in advance of any street blockage longer than 2 hours warning motorists of the date, time, and duration of the planned blockage.

6.16.9 The Contractor shall clean and restore storage areas to their original condition.

6.16.10 The University reserves the right to refuse to allow material it considers, in its sole discretion, to be a fire hazard to be stored on the University's property.

6.16.11 Gasoline and other flammable liquids shall be kept in approved safety cans at all times and shall not be stored inside University facilities.

6.16.12 The use of skid-steer loaders, track hoes, front loaders, back hoes, tractors, excavators, bulldozers, and similar equipment inside a structure is prohibited regardless of size, attachments, or type including, but not limited to, self-propelled, ride-on, or walk-behind.

Insert Section 6.17.3 as follows:

6.17.3 Interruptions to utility services shall be planned by the Contractor in coordination with the University, to provide the least inconvenience and downtime. A major utility shutdown requires a minimum of 4 weeks' notice from the Contractor. The Contractor shall provide a licensed and bonded electrician to operate all medium voltage electrical equipment and be present during the duration of the shutdown.

Insert Section 6.23.3.2 as follows:

6.23.3.2 If the Defective Work creates or contributes to a situation whereby the University is unable to occupy or use the space as intended, the Contractor shall begin to correct Defective Work within 24 hours of receiving notice.

Insert Section 6.23.5 as follows:

6.23.5 Failure to comply with this **Section 6.23** may cause the University to determine the Contractor non-responsive, which the University will use in determining the responsibility of the Contractor for award of future contracts.

Replace Section 7.9.2.1 with the following:

7.9.2.1 The Contractor shall maintain, and require its Subcontractors to maintain, complete and accurate business records in accordance with Generally Accepted Accounting Principles, at its principal place of business. If its principal place of business is not in Dayton, Ohio, the Contractor shall make records available, and shall require its Subcontractor to make records available, at the Site within 48 hours of a request for the records.

Insert Section 12.2.1.1 as follows:

12.2.1.1 The Contractor shall not advertise the fact that it has contracted with Wright State University, or make use of the University's name or other identifying marks or property, without the prior written consent of the University.

Insert Article 13 with associated Sections as follows in its entirety:

ARTICLE 13 - MISCELLANEOUS SUPPLEMENTARY CONDITIONS

13.1 Sexual Harassment

13.1.1 The University maintains an environment free from sexual harassment. Contractors and Subcontractors are hereby notified that, in accordance with University policy, prompt corrective measures will be taken to stop sexual harassment whenever it occurs in accordance with **Section 6.12.2**.

13.2 False Fire Alarms

13.2.1 As liquidated damages, and not as a penalty, the Contractor acknowledges and agrees that the Contracting Authority shall be entitled to retain or recover from the Contractor $300 or actual costs, whichever is greater, for each false fire alarm that is determined to be a result of negligence by the Contractor. This amount reflects the Contracting Authority's actual costs incurred in dealing with these false alarms, including, but not limited to, the costs of transportation, manpower, and loss of efficiency.

13.3 Safety and Health Rules

13.3.1 It is the policy of the University to provide a quality workplace environment for the learning experiences of teaching, education, work, and research which meets or exceeds Applicable Law for health and safety. The University's policy includes procedures relating to emissions by air, by liquid-carried wastes, by solid and hazardous waste disposal, or by sonic, radioactive, or electromagnetic radiation. The Contractor shall read and acknowledge by its signature that they have read and understand the policy. The University's Safety and Health Rules shall be made a part of this document and can be obtained at http://www.wright.edu. In addition the contractor shall follow and adhere to the applicable sections of the Wright State University Environmental Health and Safety Design and Construction Specifications/Requirements which are made a part of this document and can be obtained at http://www.wright.edu.

13.4 Impairment/Hot Work Permit

13.4.1 When construction operations require the impairment of the fire protection/alarm, fire suppression systems, shutdown, interruption or impairment of a utility system or require welding, cutting, burning or any open-flame/torch application, the Contractor shall follow the requirements of the University's Impairment/Hot Work Permit program. The University's Impairment/Hot Work Permit Program shall be made a part of this document in its entirety and can be obtained at http://www.wright.edu.

END OF DOCUMENT

Insert Section 1.13.2 as follows:

1.13.2 Project is not designed or be constructed under the Leadership in Energy and Environmental Design (“LEED”) Rating System developed by the U.S. Green Building Council or another rigorous rating system to be used to facilitate achievement of sustainability goals for the Project, the Contractor shall provide submittals certifying achievement of sustainable design rating system criteria for verification by the Green Building Certification Institute or other third party in accordance with the Contract Documents.

Document 00 73 43 - Wage Rate Requirements
State of Ohio Standard Requirements for Public Facility Construction

PREVAILING WAGE RATES

1.1 Payment of Prevailing Wage Rates

1.1.1 The Contractor shall pay the prevailing wage rates of the Project locality, as issued by the Ohio Department of Commerce, Wage and Hour Bureau to laborers and mechanics performing Work on the Project.

1.1.2 The Contractor shall comply with the provisions, duties, obligations, and is subject to the remedies and penalties of ORC Chapter 4115.

1.1.3 If the Contractor or its Subcontractors fail to comply with ORC Chapter 4115, the Contracting Authority may withhold payment pursuant to **Section 9.8.2.5** of the **General Conditions**. The Contractor is liable for violations committed by the Contractor or its Subcontractors to the extent provided in ORC Chapter 4115.

1.1.4 The Contractor shall submit all payroll reports in compliance with the requirements of **Section 1.2** for all employees of the Contractor and of the Contractor's Subcontractors.

1.1.5 By executing a Contract, the Contractor certifies that it based its Bid upon the prevailing rates of wages as ascertained by the Ohio Department of Commerce, Wage and Hour Bureau for the Project as provided in ORC Sections 4115.03 through 4115.14, which are inserted at the end of this Document.

1.2 Prevailing Wage Rate Revisions

1.2.1 The Contracting Authority shall, within 7 business days after receipt of a notice of a change in the prevailing wage rates, notify the Contractor of the change. The prevailing wage rates are available at the Ohio Department of Commerce's web site: http://com.state.oh.us/.

1.2.2 The Contractor shall pay any revised wage rates issued during the term of the Contract.

1.3 Payroll Schedule

1.3.1 Within 10 days of the date of the Notice to Proceed, the Contractor shall provide the Contracting Authority's Prevailing Wage Coordinator a schedule of dates during the term of the Contract on which wages shall be paid to employees for the Project.

1.4 Payroll Reports

1.4.1 The Contractor shall submit payroll reports with each Contractor Payment Request, which reports shall be certified by the Contractor that the payroll is correct and complete, and that the wage rates shown are not less than those required by the Contract. The Contractor is responsible for submitting all payroll reports of its Subcontractors.

1.4.1.1 Each payroll report shall indicate the period covered and include a list containing the name, address, and last four digits of the social security number of each employee of the Contractor and its Subcontractors paid for the Work.

1.4.1.2 Each payroll report shall list the number of hours each employee worked each day on the Project during the reporting period, the total hours each week on the Project, the employee's hourly rate of pay, job classification, hourly rate of fringe benefits, and all deductions from wages and net pay.

1.4.1.3 Each payroll report shall list each fringe benefit and state if it is paid as cash to the employee or to a named plan.

1.4.1.4 The Contractor and its Subcontractors shall submit apprenticeship agreements for all apprentices utilized on the Project with the first payroll report from the Contractor or its Subcontractor that includes apprentices.

END OF DOCUMENT

Document 00 61 13.19 - Acknowledgement of Surety (General Contracting)
State of Ohio Standard Requirements for Public Facility Construction

Project Number: _____

Project Name: _____

Owner: _____

Contracting Authority: _____

Contractor: _____

Surety Name: _____

Performance & Payment Bond No.: _____

Original Penal Sum: _____

As required under the Contract between the State of Ohio, acting by and through the Contracting Authority, and the Contractor in connection with the Project, the Surety hereby acknowledges that the Penal Sum of the above-mentioned Bond has been increased to **$**_____ *(must be not less than 100% of the Contract Sum).*

SURETY:

_____
Surety Signature

By: _____
Attorney-in-Fact

_____
Date

SURETY INFORMATION:

_____
Street

_____
City State Zip

_____
Telephone Number

SURETY AGENT'S INFORMATION:

_____
Agency Name

_____
Street

_____
City State Zip

_____
Telephone Number

END OF DOCUMENT

DIVISION 01

GENERAL REQUIREMENTS

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Project information.
2. Work covered by the Contract Documents.
3. Owner-furnished products.
4. Use of premises.
5. Owner’s right to maintain school operations.
6. Owner's occupancy requirements.
7. Work restrictions.
8. Specification formats and conventions.
9. Permits
10. Miscellaneous provisions.
11. Use of domestic steel.
12. Smoking policy.

B. Related Sections include the following:
1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Division 01 Section “Photographic Documentation” for submitting Final Completion construction photographic documentation.

1.2 PROJECT INFORMATION

A. Project Identification: Lake Campus Workforce Development Project, Project No. WSU-231035/224102.00.
1. Project Location: 7600 State Route 703, Celina, Ohio 45822

B. Owner: Wright State University, 3640 Colonel Glenn Highway, Dayton, Ohio 45435-0001
1. Robert Thompson, R.A,, University Architect.

C. A/E: Fanning Howey Associates, Inc., 128 West Market Street, Celina, Ohio 45822

D. Consultants: The A/E has retained the following design professionals who have prepared designated portions of the Contract Documents:
1. Site/Civil Engineer: Access Engineering Solutions, 1200 Irmscher Blvd., Suite B, Celina, Ohio 45822
2. Structural Engineer: Jezerinac Geers & Associates, Inc., 5640 Frantz Road, Dublin, Ohio 43017
3. Estimator: Delmax Construction Services LLC, 1557 Short Cut Road, Urbana, Ohio 43078

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work consists of the following:
1. The Project concept consists of two main components, and addition to Trenary Hall and interior renovations to Trenary Hall. The addition to Trenary Hall is planned to extend to the southeast side of the building. This addition will house a production lab, restrooms and a corridor.

1.4 PHASED CONSTRUCTION

A. The Work shall be conducted in phases as indicated on Drawings AP102.

1.5 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes providing support systems to receive Owner's equipment and making plumbing, mechanical, and electrical connections.
   1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to GC.
   2. Owner will arrange and pay for delivery of Owner-furnished items according to GC's Construction Progress Schedule.
   3. After delivery, Owner will inspect delivered items for damage. GC shall be present for and assist in Owner's inspection.
   4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
   5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to GC.
   6. Owner will furnish GC the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, GC shall designate delivery dates of Owner-furnished items in GC's Construction Progress Schedule.
   7. GC shall review Shop Drawings, Product Data, and Samples and return them to A/E noting discrepancies or anticipated problems in use of product.
   8. GC is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
   9. GC is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
   10. If Owner-furnished items are damaged as a result of GC's operations, GC shall repair or replace them.
   11. GC shall install and otherwise incorporate Owner-furnished items into the Work.

B. Owner-Furnished Products:
   1. Refer to Division 10 Section “Toilet, Bath, and Laundry Accessories”.

1.6 USE OF PREMISES (ACCESS TO SITE)

A. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
   1. Owner Occupancy: Allow for Owner occupancy of Project site and use by the public.
      a. Occupied areas must be maintained with conditioned and properly ventilated air, access to handicap restrooms, access to exists at all times. All life safety features must be maintained.
   2. Driveways and Entrances: Keep undesignated driveways, parking areas, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use undesignated areas for parking or storage of materials.
      a. Schedule deliveries to minimize use of driveways and entrances.
      b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

B. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.7 OWNER'S RIGHT TO MAINTAIN SCHOOL OPERATIONS

A. During the course of this Project, normal and customary school functions and operations must be maintained. The Contract Documents are intended to define a strict separation between the school activities of students and staff from the activities of the construction project.

B. The A/E and Owner will not tolerate any visible or audible actions initiated or responded to by any employees of subcontractor on this Project toward any students, teachers, or staff members at the school system. Violators shall be promptly removed from the Project site.

C. The Owner intends to instruct students, teachers, and staff to refrain from communications with subcontractor's personnel working on this Project. All communication with Owner and staff shall be through the A/E.
   1. Despite the Owner's instructions to refrain from doing so, individual students, teachers, staff members, or other unauthorized parties might attempt to initiate changes to the work of this Project by communicating directly with GC's or subcontractor's personnel. Do not consider these communications to be instructions either to stop work in progress or to make changes to the work of this Project; instead, refer to Article 7 ("Contract Modifications") of the General Conditions.

D. GC shall expend their best effort toward protection of the health, safety, and welfare of occupants on the Owner's property during the course of Work on this Project.

E. GC and subcontractors shall be subject to such rules and regulations for the conduct of the Work as the Owner may establish. Employees shall be properly and completely clothed while working. Bare torsos, legs, and feet will not be allowed. Possession or consumption of alcoholic beverages or drugs, tobacco, or other noxious behavior on the Project site is strictly prohibited. Violators shall be promptly removed from the Project site. Smoking is not permitted on school property or within school buildings.

1.8 OWNER'S OCCUPANCY REQUIREMENTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits, unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
   2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
      a. Wright State University requires 48 hours, in writing, for any major utility shutdown.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Contract Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
   1. Refer to Article 5 of the General Conditions.
   2. A/E will prepare a notice of partial occupancy for each specific portion of the Work to be occupied before Owner occupancy.
   3. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
   4. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
   5. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.9 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.
   1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. Definitions
   1. Ambient Noise Level: The total noise associated with a given environment, being usually a composite of normal or existing sounds from all sources near and far, excluding the noise source at issue.

2. Daytime: The hours from 7 a.m. to 9 p.m. on weekdays and 9 a.m. to 9 p.m. on weekends and holidays.
3. Nighttime: All non-daytime hours.
4. Property Line: The real or imaginary line along the ground surface and its vertical extension, which separates real property owned or controlled by one person from contiguous real property owned or controlled by another person or from any public right-of-way or from any public space.
5. Receiving Noise Area: Any real property where people live or work and where noise is heard, excluding the project or source area.

C. On-Site Work Hours: Work shall be generally performed during normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except as otherwise indicated.
1. Work performed outside of normal business hours on weekends, early morning or evening must be prearranged with A/E and Owner a minimum of 24 hours in advance.
a. GC's superintendent/foreman must be on-site while work is being performed.

D. Noise Control: Perform deconstruction, renovation, and construction operations to minimize noise. Coordinate operations that may result in high levels of noise or other disruption to Owner occupancy with Owner.
1. Notify A/E and Owner not less than two days in advance of proposed disruptive operations.

E. Repetitive and/or intermittent, high-level noise: Permitted only during daytime.
1. Do not exceed the following dB limitations:

Sound Level in dB	Time Duration of Impact Noise
70	More than 12 minutes in any hour
80	More than 3 minutes in any hour

2. Provide equipment, sound-deadening devices, and take noise abatement measures that are necessary for compliance.
3. Maximum permissible construction equipment noise levels at 50 feet (dB):

EARTHMOVING	dB	MATERIALS HANDLING	dB
Front Loaders	75	Concrete Mixers	75
Backhoes	75	Concrete Pumps	75
Dozers	75	Cranes	75
Tractors	75	Derricks Impact	75
Scrapers	80	Pile Drivers	95
Graders	75	Jack Hammers	75
Trucks	75	Rock Drills	80
Pavers, Stationary	80	Pneumatic Tools	80
Pumps	75	Saws	75
Generators	75	Vibrators	75
Compressors	75		

F. Ambient Noise:
1. Maximum noise levels (dB) for receiving noise area at property line shall be as follows:
a. Residential receiving area — Daytime: 65 dB; Nighttime: 60 dB
b. Commercial/Industrial receiving area — Daytime: 67 dB; Nighttime: 65 dB
2. In the event the existing local ambient noise level exceeds the maximum allowable receiving noise level (dB), the receiving noise level maximum for construction operations shall be adjusted as follows:
a. Residential receiving area: Maximum 3 additional dB above the local ambient as measured at property line.
b. Commercial/Industrial receiving area: Maximum 5 additional dB above the local ambient as measured at the property line.

G. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Refer to Article 2 of the General Conditions.
   2. Notify A/E and Owner not less than 72 hours in advance of proposed utility interruptions.
   3. Do not proceed with utility interruptions without Owner's and A/E's written permission.

H. Employee Identification: Provide identification tags for GC personnel working on Project site. Require personnel to use identification tags at all times.

I. Employee Screening: Comply with Owner's requirements for drug and background screening of GC personnel working on Project site.
   1. All construction personnel shall be enrolled in an remain in good standing in the Ohio Bureau of Workers' Compensation ("OBWC") Drug-Free Safety Program ("DFSP") or a comparable program approved by the OBWC that meets the requirements specified in ORC Section 153.03 ("OBWC – approved DFSP").
   2. Maintain list of approved screened personnel with Owner's representative.
   3. A background inquiry for the construction work force is a requirement of the construction contract. No one will be permitted to work on school construction projects adjacent to active school facilities without the completion of a satisfactory background inquiry.
      a. Documentation shall be submitted within 10 days of Notice to Proceed. Construction work at the project site cannot start without properly screened personnel.
   4. Data Collection:
      a. Applicants provide; name, address, SSN, employment reference and consent to background check.
      b. Information along with a photograph of applicant shall be provided Owner along with results of each criminal background search.
      c. Provide a complete listing of all screened individuals sorted by serial number with person's name, phone number and employer and employer phone number.
   5. Criminal Background Check: During the course of construction projects, including renovation/rehabilitation projects and new construction taking place in close proximity to an occupied school building, the Wright State University ("Owner") desires to protect its students and employees from individuals who may have criminal records. The Owner requires that all construction workers on renovation projects and on construction of a new school building that is in close proximity to an occupied building, where school is in session at the time the work is being performed, must undergo a criminal background investigation and FBI check ("Criminal Background Check"), as specified in Ohio Revised Code Section 3319.39. In addition to the Criminal Background Check, the Owner requires each worker on a construction project to which this requirement applies to obtain a sticker from the GC after the Owner has reviewed the Criminal Background Check results, which each worker will affix to his or her hard hat and have with him or her at all times when on the construction site.
      a. Except as provided in paragraphs c. and d. of this requirement, no construction worker shall be permitted to perform work on a construction project undertaken by the Owner where school is in session on the same site, if the worker has been convicted of or pleaded guilty to any of the following:
         1) A violation of the following Ohio Revised Code sections:

O.R.C. Section	Violation
2903.01, 2903.02	Murder or aggravated murder
2903.03, 2303.04	Voluntary or involuntary manslaughter
2903.11, 2903.12, 2903.13	Assault, felonious assault, aggravated assault
2903.16	Failing to provide for a functionally impaired person
2903.21	Aggravated menacing
2905.01, 2905.02	Kidnapping, abduction
2905.04, 2905.05	Child stealing or child enticement
2907.02	Rape
2901.03	Sexual battery

2907.12	Felonious sexual penetration
2907.05, 2907.06	Sexual imposition or gross sexual imposition
2907.04	Corruption of a minor
2907.07	Importuning
2907.08	Voyeurism
2907.09	Public indecency
2907.23, 2907.25	Prostitution or procuring prostitution
2907.21, 2907.22	Compelling or promoting prostitution
2907.32, 2907.321	Pandering obscenity and/or child pornography
2907.31	Disseminating matter harmful to juveniles
2907.322	Pandering any sexually oriented materials involving or depicting minors
2907.323	Use of minor in nudity-oriented materials or performance
2911.01, 2911.02	Robbery or aggravated robbery
2911.11, 2911.12	Burglary or aggravated burglary
2919.22	Endangering children
2919.24	Contributing to unruliness or delinquency of child
2923.12	Carrying concealed weapon
2923.13	Having weapon while under disability
2925.02	Corrupting another with drugs
2925.03	Trafficking in drugs
3716.11	Placing harmful objects or substances in food
3319.31	Any other drug abuse offense which is not a minor misdemeanor

2) A violation of any existing or former law of this State, any other State, or the United States, if the offense is substantially equivalent to any of the offenses described above.

b. The Owner may permit a construction worker to work conditionally until the Criminal Background Check is completed and the Owner receives the results of the check. If the results of the Criminal Background Check indicate that, pursuant to this policy, the worker does not qualify to work on a Owner project, the GC shall immediately remove the worker from the site. The sticker issued by the Owner will be conditioned upon a satisfactory Criminal Background Check.

c. Except as provided in paragraph d. of this requirement, a construction worker who has been convicted of or pleaded guilty to a violation of O.R.C. Sections 2903.13, 2903.16, or 2903.21 may be permitted to work if all of the following conditions are met:

1) The offense was a misdemeanor.
2) The victim of the offense was not a person under eighteen (18) years of age.
3) At least five (5) years have elapsed since the worker was fully discharged from imprisonment, probation, and parole, or the worker has had the record of his/her conviction sealed pursuant to O.R.C. 2953.32.
4) The worker provides written confirmation by a Court, his/her parole officer, and/or counselor that the worker has been rehabilitated.
5) The worker's hiring will not jeopardize in any way the health, safety, or welfare of the persons served by the school. The following factors must be considered in determining whether the worker's hiring will jeopardize the persons served by the school:
   a) The worker's age at the time of the offense.
   b) The age and ability of the victim, including whether the victim is an individual with physical or mental disabilities.
   c) The nature and seriousness of the offense.
   d) The circumstances under which the offense was committed.
   e) The degree to which the worker participated in the offense.
   f) The time elapsed since the worker was fully discharged from imprisonment, probation, and parole.

g) The likelihood that the circumstances leading to the offense will recur.
h) Whether the worker is a repeat offense, “Repeat offender” means a person who has been convicted of or pleaded guilty to the commission of any of the offenses listed in paragraph b. of this requirement two (2) or more times in separate criminal actions. Convictions or guilty pleas resulting from or connected with the same act, or resulting from offenses committed at the same time, shall be counted as one conviction or guilty plea.
i) The extent to which the job assigned this worker is employed provides an opportunity for the commission of an offense listed in paragraph b. of this requirement.
j) The worker’s employment record.
k) The worker’s efforts at rehabilitation and the results of those efforts.
l) Whether any criminal proceedings are pending against the worker.

d. It is the worker’s responsibility to provide written proof that the conditions specified in paragraph c. of this requirement are met. If the worker fails to provide such proof or if the Owner determines that the proof offered by the worker is inconclusive, the worker shall not be allowed to work on a Owner project. Any doubt shall be resolved in favor of protecting the persons served by the Owner.

e. This requirement is applicable to records of convictions that have been sealed pursuant of the Ohio Revised Code when the information contained in those sealed records bears a direct and substantial relationship to the job for which the worker will be employed.

f. A conviction of or a plea of guilty to an offense listed in paragraph a. of this requirement shall not prevent a worker from working on a school project if the worker has been granted an unconditional pardon for the offense pursuant to law. For purposes of this policy, “unconditional pardon” includes a conditional pardon with respect to which all conditions have been performed or have transpired.

g. This construction project requirement applies to all employees of a GC holding a construction contract awarded by the Owner, who are performing work at the construction site, and the employees of all GC’s subcontractors to a GC who will be performing work on site. The employees of material suppliers will only be subject to this requirement if they are delivering materials and equipment to the building while school is in session. The General Contractor may request that a specific employee obtain the required Criminal Background Check if it has not already done so, and the GC will comply with this request without delay.

6. Project Site Compliance Monitoring:
   a. After successful completion of the criminal history search, the screening firm shall provide the applicant with a form of identification to be displayed on the applicant’s hard hat or employee identification tags. Identification shall be displayed at all times.
      1) Identification shall not directly identify the applicant’s personal information.
   b. Random checks will be performed to verify through brief random sampling that:
      1) There are no construction personnel working without a background check and proper identification.
      2) GC is maintaining a sign-in sheet for personnel visiting Project and providing a background-compliant full-time escort.
7. Tracking and Reporting: Deliver background inquiry reports to the Owner in hard copy and PDF format.
8. GC shall include cost of initial screening and reporting in their bid.

J. The implementation and adherence of the COVID-19 safety protocols are the responsibility of the companies, as are all other aspects of worker safety. These safety protocols may be updated time to time, and in accordance with other guidelines and orders.
   1. For more information and resources about COVID-19, visit coronavirus.ohio.gov and call 1-833-4-ASK-ODH with your questions. You may also contact your local health department.

1.10 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "MasterFormat" numbering system.
   1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
   2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
   2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by GC. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by GC or by others when so noted.
      a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.11 PERMITS, FEES, AND NOTICES

A. Contractor shall secure and pay for permits, inspections, and licenses necessary for the proper execution and completion of Work, which are applicable at the time the bids are received, unless otherwise noted.
   1. A/E shall assist the Owner in applying for “Certificate of Plan Approval” (General Building Permit) typically required by law for projects similar to the one for which the A/E’s services are engaged. Owner will pay associated fees.

B. Utility Tie-Ins: Shall be arranged with local utility company and other involved parties for minimum interruption of service.

C. Inspections of installed work shall be performed by the governing authority as arranged for by the Contractor. Work shall not be covered until approved.

D. Contractor shall give notices and comply with laws, ordinances, rules, regulations, and orders of public authorities bearing on the performance of his Work. If a Contractor observes that the Contract Documents are at variances therewith, he shall promptly notify the **A/E** in writing, and necessary changes shall be adjusted by appropriate notification. If a Contractor performs Work knowing it to be contrary to such laws, ordinances, rules, and regulations, and without such notice to the **A/E**, he shall assume full responsibility therefore and shall bear the costs attributable thereto.

1.12 MISCELLANEOUS PROVISIONS

A. GC shall enforce strict discipline and good order among his employees or other persons carrying out Work of his Contract and shall not permit employment of unfit person or persons or anyone not skilled in the task assigned to them.

B. When verification of existing dimensions is required, the GC requiring said verification for the construction or fabrication of his material shall be the GC responsible for the procurement of the field information.

C. Do not scale documents.

D. Hazardous Materials: The GC in addition to products banned as part of the Clean Air Act (NESHAP Rule, Nov. 1990 Revision; 40 CFR 60, Subpart M) shall not use or bring on-site materials containing more than 1 percent asbestos by polarized-light microscopy (PLM) analysis. No materials marked as "MAY CONTAIN MINERAL FIBERS" shall be used in construction unless written results of microscopic examination by an AIHA or NVLAP-certified laboratory documenting the asbestos content at less than 1 percent are provided and approved before installation.
   1. If materials containing more than 1 percent asbestos are brought onto Project site by GC, materials shall be removed in accordance with all applicable laws and precautions so as not to make fibers friable. Removal of materials containing more than 1 percent asbestos and replacement of such materials shall be at GC's expense.
   2. Before final payment, the GC shall submit to the Owner, on contracting firm's letterhead, a signed, dated copy of the following statement:
      a. I hereby certify to the best of my knowledge that no asbestos containing material (ACM) above 1 percent content was used as a building material for this Project.

1.13 USE OF DOMESTIC STEEL:

A. For this Project all load-bearing structural steel (as defined herein) shall be fabricated and produced using, to the best of the GC's Knowledge, only steel made in the United States in accordance with Sections 153.011 and 153.99 of the Ohio Revised Code (ORC).
   1. Load Bearing Structural Steel – Definition. For the purpose of this article, the following definition and clarification shall be applied:
      a. Steel products used for load-bearing structural purposes shall be defined as "structural steel", per the American Institute of Steel Construction, Inc. (AISC) definition in its Manual of Steel Construction, latest edition, and are thereby required to be produced and fabricated only from steel made in the United States.
      b. For clarification purposes the 9th Edition of the Manual of Steel Construction, lists the following as structural steel:
         1) Anchor bolts for structural steel; base or bearing plates; beams, girders, purlins, and girts; bearings of steel for girders, trusses or bridges; bracing; columns and posts; connecting materials for framing structural steel to structural steel; crane rails, splices, stops, bolts, and clamps; door frames constituting part of the steel frame; expansion joints connected to steel frame; fasteners for connecting structural steel items including shop rivets, permanent shop bolts, shop bolts for shipment, field rivets and bolts for permanent connections, and permanent pins; floor plates (checkered or plain) attached to steel frame; grillage beams and girders; hangers essential to the structural steel frame; leveling plates, wedges, shims, and leveling screws; lintels, if attached to the structural steel frame; marquee or canopy framing; machinery foundations of rolled steel sections and/or plate attached to the structural frame; monorail elements of standard structural shapes when attached to the structural frame; roof frame of standard structural shapes; shear connectors if specified shop attached; struts, tie rods, and sag rods forming part of the structural frame; and trusses.
      c. For the purpose of clarification, the following shall also be defined as load-bearing structural steel.
         1) All structural steel shapes including, but not limited to "W", "M", "S", "HP", "C", "MC", and "L" shapes (as defined by AISC); structural steel pipe and structural tubes of any dimension, thickness and length; structural tees cut from other shapes, all composite steel beams or columns made from a combination of structural steel shapes, and all steel plates used for stiffening structural steel shapes and as base plates.

B. Definition and clarification of products NOT considered load-bearing. For the purposes of this directive, the following definitions and clarifications shall apply:

1. Non-load bearing steel products shall be defined as those items NOT defined as "structural steel" by the American Institute of Steel Construction, Inc. (AISC) in its *Manual of Steel Construction*, latest edition, even when such items are shown on the structural steel plans or are attached to the structural frame.
2. Items defined by this directive as non-load bearing shall NOT be required to be produced or fabricated from steel produced in the United States.
3. The 9th edition of the *Manual of Steel Construction*, lists the following as NOT structural steel (and is subject to change):
    a. Cables for permanent bracing or suspension systems, chutes and hoppers, cold-formed steel products, door and corner guards, embedded steel parts in precast or poured concrete, flagpole support steel, floor plates (checkered or plain) not attached to the steel frame, grating and metal deck, items required for the assembly or erection of materials supplied by trades other than structural steel fabricators or erectors, ladders and safety cages, lintels over wall recesses, non steel bearings, open-web long-span joists and joist girders, ornamental metal framing, shear connectors field installed, stacks, tanks, and pressure vessels, stairs, catwalks, handrail and toe plates, and trench or pit covers.
4. For the purposes of this directive, DAS also defines the following as NOT structural steel, including but not limited to:
    a. Reinforcing steel of plain or deformed rods of any size, metal grids for suspended ceiling systems, ornamental steel, architectural metal, framing members fabricated from sheet-gauge steel, steel handrails, open-web joists of any length, siding and roofing panels, steel stair treads, tread pans and tread risers, enclosures for mechanical equipment, electrical equipment and conveying systems, (including the platforms for and supporting frames, rails, and thresholds for elevators, escalators, lifts, hoists and stage lifts for theatres); pipe used for transporting liquids, gases, and solids and the associated pipe hangers.

C. Enforcement
1. Revised Code, Sec. 153.99 (A) allows for the assessment of "...a civil penalty equal to one and one-half times the purchase price of the steel products purchased or provided...".
    a. For the purposes of this directive, the aforementioned “purchase price” shall be interpreted as that price indicated on invoices issued by a selling entity to a purchasing entity for products purchased or provided.
2. Sec. 153.011 (C) states, in part: "Whenever the Director of Administrative Services has reasonable cause to believe that any person has purchased or provided steel products in violation...the Director shall conduct an investigation...".
    a. For the purposes of this directive, the Director may delegate such investigations to the Office of the State Architect who may delegate to another entity or entities as deemed appropriate. The investigation may access construction and office sites, work in progress and materials stored on-site or off-site and may investigate any and all written and electronic records associated with a project.
3. All construction documents prepared for projects effected by this directive shall include provisions for the monitoring of those projects for potential violations and shall provide for appropriate reporting to the Office of the State Architect of any observed or suspected violations.

D. Authority and Reference: ORC 153.011 and ORC 153.99.

1.14 SMOKING POLICY

A. Smoking Ban:
1. Smoking is prohibited in any “public place” or “place of employment” as of December 7, 2006. For definitions of a “public place” and “place of employment,” refer to ORC 3794.01 Definitions.
2. All “public places” and “places of employment” must, by December 7, 2006, post conspicuous signs at each entrance. The signs shall be clearly legible and shall contain a toll-free number for reporting violations. Refer to ORC 3794.06 (A) Posting of Signs.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

B. Related Sections include the following:
   1. Division 00 Section “Bid Form”.
   2. Division 01 Section "Allowances" for procedures for using unit prices to adjust quantity allowances.

1.2 DEFINITIONS

A. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject GC's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to GC.

D. List of Unit Prices: A list of unit prices is included on the Bid Form. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.
   1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, and in accordance with Section 31 20 00 “Earth Moving”.
   2. Unit of Measurement: Cubic yard of soil excavated, based on in-place surveys of volume before and after removal.
   3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 01 21 00 “Allowances”.

END OF SECTION 01 22 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on Bid Form for certain work defined in Bidding Requirements that may be added to or deducted from Base Bid amount if Owner decides to accept a corresponding change either in quantity of construction to be completed or in products, materials, equipment, systems, or installation methods described in Contract Documents.
   1. The cost or credit for each alternate is net addition to or deduction from Contract Sum to incorporate alternate into Work. No other adjustments are made to Contract Sum.
   2. Alternates described in this Section are part of Work only if enumerated in Agreement.

1.3 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of Contract, notify each entity involved, in writing, of status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under same conditions as other work of Contract.

D. Schedule: A Schedule of Alternates is included at end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Corridor Refurbish
   1. Base Bid: Provide only work necessary to accommodate new work as indicated as Base Bid in Corridors 108A and 108B.
   2. Alternate: Provide all Work, including interior updates to Room Nos. 108A and 108B.

B. Alternate No. 2: Temperature Control System
   1. Base Bid: Provide modification to temperature control system in existing Room Nos. 108A, 108B, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, and 122.
   2. Alternate: Provide Work for Tridium/Niagra unified temperature control system for entire building.

C. Alternate No. 3: West Entrance Canopy Replacement
   1. Base Bid: No added work.
   2. Alternate: Provide for replacement of canopy on existing west entrance at Room No. 123.

D. Alternate No. 4: Screening Mechanical Yard
   1. Base Bid: No added work.
   2. Alternate: Provide screening of existing mechanical yard as indicated on L-101 and specified in Division 32 Sectio “Chain Link Fences and Gates”.

E. Alternate No. 5: Refinish Room No. 133
   1. Base Bid: No new work in Room No. 133 – Material Science Room.
   2. Alternate: Refinish Room No. 133 - Material Science Room, including new solid vinyl floor tile (SVT), vinyl base, and repaint as indicated.

F. Alternate No 6: Landscaping
   1. Base Bid: Provide no additional landscape Work.
   2. Alternate: Provide landscaping as indicated on L-501 and specified in Division 32 Section “Plants”.

END OF SECTION 01 23 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:
1. Division 01 Section "Alternates" for products selected under an alternate.
2. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
3. Divisions 02 through 33 Sections for specific requirements and limitations for substitutions.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by Contract Documents and proposed by Contractor.
1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Use facsimile of form provided in Project Manual.
2. Documentation: Show compliance with requirements for substitutions and following, as applicable:
a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or revisions needed to other parts of Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES, if applicable.

j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for Work, including effect on overall Contract Time. If specified product or method of construction cannot be provided within Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. A/E's Action: If necessary, A/E will request additional information or documentation for evaluation within 10 days of receipt of a request for substitution. A/E will notify Contractor acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
   a. Forms of Acceptance: Change Order.
   b. Use product specified if A/E does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

B. Variation from Materials Specified: It is intended that materials or products specified by name of manufacturer, brand, and trade name or by catalog reference shall be the basis of the bid and furnished under the contract, unless changed by mutual agreement. Where two or more materials are named, the choice of these shall be optional with the contractor. Should the contractor wish to use any materials or products other than those specified, they shall so state, naming the proposed substitutions and stating what difference, if any, on the form herein. If accepted the product, including any possible cost modification shall be made part of the contract.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: A/E will consider Contractor's request for substitution when following conditions are satisfied. If following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
   a. Requested substitution is consistent with Contract Documents and will produce indicated results.
   b. Substitution request is fully documented and properly submitted.
   c. Requested substitution will not adversely affect Contractor's construction schedule.
   d. Requested substitution has received necessary approvals of authorities having jurisdiction.
   e. Requested substitution is compatible with other portions of Work.

f. Requested substitution has been coordinated with other portions of Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Construction Progress Schedule.
      a. Article 6.5 “Construction Progress Schedule of the General Conditions”.
   2. Daily construction reports.
   3. Material location reports.
   4. Field condition reports.
   5. Use of site plan.
   6. Special reports.
   7. Project meetings.
      a. Article 6.6 “Progress Meetings”.

B. Related Sections include the following:
   1. Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
   2. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
   3. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.2 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in electronic format:

B. Construction Progress Schedule: Submit copies of initial schedule, large enough to show entire schedule for entire construction period.

C. Daily Construction Reports: Submit at weekly intervals.

D. Material Location Reports: Submit at monthly intervals.

E. Field Condition Reports: Submit at time of discovery of differing conditions.

F. Special Reports: Submit at time of unusual event.

PART 2 - PRODUCTS

2.1 CONSTRUCTION PROGRESS SCHEDULE, GENERAL

A. Refer to “Construction Progress Schedule” in Article 6.5 “Construction Progress Schedule of the General Conditions” of the General Conditions.

2.2 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
   1. List of subcontractors at Project site.
   2. List of separate contractors at Project site.
   3. Approximate count of personnel at Project site.
   4. Equipment at Project site.
   5. Material deliveries.
   6. High and low temperatures and general weather conditions.
   7. Accidents.

8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Work/Change Orders received and implemented.
15. Services connected and disconnected.
16. Equipment or system tests and startups.
17. Partial Completions and occupancies.
18. Contract Completions authorized.

B. Material Location Reports: Prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list of statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.3 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within 3 days of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by GC's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

2.4 PROJECT USE OF SITE PLAN

A. The General Contractor, in cooperation with subcontractors on this Project, will prepare a proposed Project Use of Site Plan.

B. Confine operations at the Project site to areas within the areas indicated and as approved on the Use of Site Plan, and as permitted by law, ordinances, and permits. Site shall not be unreasonably encumbered with materials, products, or construction equipment.

C. Proposed Use of Site Plan shall include access to proposed building for construction purposes, storage of materials and products, parking, where possible, for employees, temporary facilities including offices, storage, and workshop sheds or portable trailers, and unloading space.
1. Indicate staff and student access routes; zoning of building areas; temporary exists to eliminate dead-end corridors during construction.
    a. Indicate how mechanical systems air handling units are zoned and ductwork routed, so construction can be isolated without affecting air distribution in occupied areas.
    b. Indicate routing of existing electrical feeders and switchgear to ensure occupied spaces have continuous power sourcing.
    c. Indicate where temporary partitions will be used to protect students.
    d. Designate staging areas protected from students and public.

D. The Owner will indicate which portions of the existing parking lot and nonpaved areas can be used for construction activities. Damage to existing parking lot or unpaved areas shall be paid for by the GC.

E. Construction fencing to separate areas from students, staff and visitors.

2.5 PROGRESS MEETINGS

A. Refer to General Conditions Article 6.6 “Progress Meetings”.

B. Owner requires job meeting notes be written and distributed no later than 2 business days after meeting has taken place.

C. All correspondence requires involvement and communication shall be copied to WSU Project Manager.

D. Meeting notes shall be written with date and attendance recorded. Items discussed are to be separated into Old and New Business with open items and action plans noted.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Preconstruction photographs.
   2. Concealed Work photographs.
   3. Periodic construction photographs.

B. Related Requirements:
   1. Division 00 Section “Supplementary Conditions” for additional preconstruction video requirements.
   2. Division 01 Section "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
   3. Division 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
   4. Division 02 Section "Selective Demolition" for photographic documentation before selective demolition operations commence.
   5. Division 31 Section "Site Clearing" for photographic documentation before site clearing operations commence.

1.2 ALLOWANCES

A. Basis for Bids: Base number of periodic construction photographs on average of 20 digital photographs per week over duration of Project.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.
   1. Submit photos on CD-ROM or thumb-drive. Include copy of key plan indicating each photograph's location and direction.
   2. Identification: Provide the following information with each image description in file metadata tag:
      a. Name of Project.
      b. Name and contact information for photographer.
      c. Name of A/E.
      d. Name of General Contractor.
      e. Date photograph was taken.
      f. Description of location, vantage point, and direction.
      g. Unique sequential identifier keyed to accompanying key plan.

C. Video Recordings: Submit video recordings within seven days of recording.
   1. Submit video recordings on CD-ROM or thumb drive. Include copy of key plan indicating each video's location and direction.
   2. Identification: With each submittal, provide the following information in file metadata tag:
      a. Name of Project.
      b. Name and contact information for photographer.
      c. Name of A/E.
      d. Name of Contractor.
      e. Date video recording was recorded.
      f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

3. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in three-ring binders. Provide label on front and spine. Include a cover sheet with label information. Include name of Project and date of video recording on each page.

1.4 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.5 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of **12** megapixels and capable of recording in full high-definition mode. Provide supplemental lighting in low light levels or backlit conditions.

C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

D. Metadata: Record accurate date and time from camera.

E. File Names: Name media files with date, Project area and sequential numbering suffix.

1.6 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.
1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
1. Underground utilities.
2. Underslab services.
3. Piping.
4. Electrical conduit.

D. Periodic Construction Photographs: Take 20 photographs weekly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. Additional Photographs: A/E may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:
   a. Special events planned at Project site.
   b. Immediate follow-up when on-site events result in construction damage or losses.
   c. Photographs are to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.

d. Substantial Completion of a major phase or component of the Work.
e. Extra record photographs at time of final acceptance.
f. Owner's request for special publicity photographs.

1.7 CONSTRUCTION VIDEO RECORDINGS

A. Video Recording Photographer: Engage a qualified videographer to record construction video recordings.

B. General: Refer to Supplementary Conditions, Subparagraph 6.10.6.

C. Preconstruction Video Recording: Before starting excavation and demolition, record video recording of Project site and surrounding properties from different vantage points, as directed by A/E.
1. Flag excavation areas and construction limits before recording construction video recordings.
2. Show existing conditions adjacent to Project site before starting the Work.
3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of excavation, demolition, and construction.
4. Show protection efforts by Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 33

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve General Contractor of responsibility for compliance with Contract Document requirements.
   1. Specific quality-assurance and -control requirements for individual construction activities are specified in Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit GC's other quality-assurance and -control procedures that facilitate compliance with Contract Document requirements.
   3. Requirements for GC to provide quality-assurance and -control services required by A/E, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include following:
   1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
   2. Division 01 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
   3. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of Work to evaluate that actual products incorporated into Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by A/E.

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish standard by which Work will be judged.
   1. Integrated Exterior Mockups: Mockups of exterior envelope erected separately from building but on project site, consisting of multiple products, assemblies and subassemblies.

D. Preconstruction Testing: Tests and inspections that are performed specifically for Project before products and materials are incorporated into Work to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an accredited, independent testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

F. Source Quality-Control Testing: Tests and inspections that are performed at source, i.e., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean same as testing agency.

I. Installer/Applicator/Erector: GC or another entity engaged by GC as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of corresponding generic name.

J. Experienced: When used with an entity or individual, “experienced” means having successfully completed a minimum of three previous project similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and standards establish different or conflicting requirements for minimum quantities or quality levels, comply with most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to A/E for a decision before proceeding.

B. Minimum Quantity or Quality Levels: Quantity or quality level shown or specified shall be minimum provided or performed. Actual installation may comply exactly with minimum quantity or quality specified, or it may exceed minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for context of requirements. Refer uncertainties to A/E for a decision before proceeding.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Testing Agencies Qualification: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in form of a recent report on inspection of testing agency by a recognized authority.

B. Schedule of Tests and Inspections: Prepare in tabular form and include following:
   1. Specification Section number and title.
   2. Description of test and inspection.
   3. Identification of applicable standards.
   4. Identification of test and inspection methods.
   5. Number of tests and inspections required.
   6. Time schedule or time span for tests and inspections.
   7. Entity responsible for performing tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of Work and test and inspection method.
   7. Identification of product and Specification Section.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of Work.

E. GC's Quality Control Plan: For quality-assurance and quality-control activities and responsibilities.

1.5 GC'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out GC's quality-assurance and quality-control responsibilities. Coordinate with Construction Progress Schedule.
1. Contractor prior to the start of any project is to prepare for WSU review of their quality control plan and strategies for insuring quality and schedule adherence.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: Include in quality-control plan a comprehensive schedule of Work requiring testing or inspection, including following:
1. GC-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and GC-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on "Statement of Special Inspections."
3. Owner-performed tests and inspections indicated in Contract Documents, including tests and inspections indicated to be observed by Testing Agent, i.e. Division 04 Section "Unit Masonry" article "Source Quality Contract".

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

G. Coordination: Coordinate activities included in various sections to assure efficient and orderly installation of each component. Coordinate operations included under different Sections that are dependent on each other for proper installation and operation.
1. Interior Finishes: Schedule construction operations with consideration for indoor air quality.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of Work and test and inspection method.
   7. Identification of product and Specification Section.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
   10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
   11. Comments or professional opinion on whether tested or inspected Work complies with Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include following:
   1. Name, address, and telephone number of technical representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.
   3. Statement that products at Project site comply with requirements.
   4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
   5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   6. Statement whether conditions, products, and installation will affect warranty.
   7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include following:
   1. Name, address, and telephone number of factory-authorized service representative making report.
   2. Statement that equipment complies with requirements.
   3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   4. Statement whether conditions, products, and installation will affect warranty.
   5. Other required items indicated in individual Specification Sections.

1.7 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of system, assembly, or product that is similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for activities indicated.
   1. Requirement for specialists shall not supersede building codes and regulations governing Work.

G. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

H. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with following:
   1. GC responsibilities include following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying Work.
      c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
      d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
      e. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
   2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to A/E, with copy to GC. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from Contract Documents.

I. Mockups: Before installing portions of Work requiring mockups, build mockups for each form of construction and finish required to comply with following requirements, using materials indicated for completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, as directed by A/E.
   2. Notify A/E 7 days in advance of dates and times when mockups will be constructed.
   3. Demonstrate proposed range of aesthetic effects and workmanship.
   4. Obtain A/E's approval of mockups before starting work, fabrication, or construction.
      a. Allow 7 days for initial review and each re-review of each mockup.
   5. Maintain mockups during construction in an undisturbed condition as a standard for judging completed Work.

J. Integrated Exterior Mockups: Construct integrated exterior mockup as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual specification sections, along with supporting materials.

1.8 QUALITY CONTROL

A. Owner/A/E Responsibilities: Where quality-control services are indicated as Owner's/A/E's responsibility, Owner will engage a qualified testing agency to perform these services.

1. A/E/Owner will furnish GC with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with Contract Documents will be charged to Contractor, and Contract Sum will be adjusted by Change Order.

B. Tests and inspections not explicitly assigned to Owner/A/E are GC's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of GC by authorities having jurisdiction, whether specified or not.
1. Where services are indicated as GC's responsibility, engage a qualified testing agency to perform these quality-control services.
    a. GC shall not employ same entity engaged by Owner/A/E, unless agreed to in writing by Owner.
2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as GC's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by GC and not required by Contract Documents are GC's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were GC's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with Contract Documents.

E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide following:
1. Access to Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspecting equipment at Project site.

F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

G. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by Contract Documents. Submit schedule within 30 days of date established for Notice to Proceed.
1. Distribution: Distribute schedule to Owner, A/E, testing agencies, and each party involved in performance of portions of Work where tests and inspections are required.

1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner/A/E will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as responsibility of Owner/A/E, and as follows:
   1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing completeness and adequacy of those procedures to perform Work.
   2. Notifying A/E, General Contractor, and subcontractor promptly of irregularities and deficiencies observed in Work during performance of its services.
   3. Submitting a certified written report of each test, inspection, and similar quality-control service to A/E and to authorities having jurisdiction.
   4. Submitting a final report of special tests and inspections at Contract Completion, this includes a list of unresolved deficiencies.
   5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from Contract Documents.
   6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include following:
   1. Date test or inspection was conducted.
   2. Description of Work tested or inspected.
   3. Date test or inspection results were transmitted to A/E.
   4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for A/E's reference during normal working hours.
   1. Submit log at Project Closeout as part of Project Record documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
   2. Comply with Contract Document requirements for Division 01 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are GC's responsibility, regardless of assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in Division 00 Section “Contracting Definitions”.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. “Project Site”: Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which the Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
   1. Refer to Article 6 of the General Conditions.

B. Related Sections include the following:
   1. Division 01 Section "Summary" for limitations on utility interruptions and other work restrictions.
   2. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
   3. Division 01 Section "Construction Cleaning" for progress cleaning requirements.
   4. Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
   5. Division 06 Section “Miscellaneous Rough Carpentry” for lumber and plywood requirements.
   6. Division 09 Sections “Exterior Painting” and “Interior Painting” for painting requirements.
   7. Division 31 Section “Site Clearing” for temporary tree and plant protection.
   8. Division 31 Section “Earth Moving” for disposal of ground water at Project site.
   9. Division 32 Section "Asphalt Paving" for construction and maintenance of asphalt paving for temporary roads and paved areas.

1.2 USE CHARGES

A. Refer to Article 6 of the General Conditions.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Use-of-Site Plan: Show temporary facilities, utility lines and connections, staging areas, parking areas, and vehicle circulation for construction personnel and construction site entrances.

B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate GC personnel responsible for management of fire-prevention program.
   1. Fire-Protection Plan: Prepare a written plan for preventing fires during Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner’s fire-protection equipment and requirements.

C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, and mold. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.
   1. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

D. Dust-Control and HVAC-Control Plan: Submit combined coordination drawing and narrative that indicates the dust-control and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
   1. Locations of dust-control partitions at each phase of the work.
   2. HVAC system isolation schematic drawing.

3. Location of proposed air filtration system discharge.
4. Other dust-control measures.
5. Waste management plan.

E. Noise and Vibration Control Plan: Identify construction activities that might impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by Owner. Include the following:
1. Methods used to meet the goals and requirements of Owner.
2. Concrete cutting methods to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with Owner.

1.4 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:
1. Building code requirements
2. Health and safety regulations
3. Utility company regulations
4. Police, fire department, and rescue squad rules
5. Environmental protection regulations

B. Standards: Comply with NFPA 241 “Standard for Safeguarding Construction, Alternations, and Demolition Operations”, ANSI A10 Series Standards for “Safety Requirements for Construction and Demolition,” and NECA Electrical Design Library “Temporary Electrical Facilities”.
1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 “National Electric Code”.

C. Design Standards: Requirements for temporary facilities are minimum standards. Provide additional facilities as required for proper execution of Work and to meet responsibilities for protection of persons and property.
1. Fabricate and label refrigeration system to comply with ASHRAE 15, “Safety Code for Mechanical Refrigeration.”
2. Desiccant Wheels: Bacteriostatic and non-toxic, glass fibers which form support matrix shall be made from uniform continuous strands larger than 5 microns in diameter that are non-respirable and are not considered a possible health risk by International Agency for Research on Cancer (IARC). Wheels shall be tested according to ASTM E84-90 (“Standard Test Method for Surface Burning Characteristics of Building Materials”) and shall achieve a flame spread index of 0 and a smoke developed index of 10.
3. Once building is enclosed and finishes are beginning to be applied, take and record the following measurements:
a. Contractor shall install temperature and relative humidity gauges for each unit of the facility or as deemed acceptable by the A/E.
b. Contractor shall record daily readings in their log.

D. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

E. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural and Transportation Barriers Compliance Board’s ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

F. Additional Requirements:
1. WSU requires 48 hours’ notice, in writing, for any major utility shown down.

2. Occupied areas must be maintained with conditioned and properly ventilated air, access to handicap restrooms, access to exists at all times. All life safety features must be maintained or added to maintain within occupied areas.

1.5 PROJECT CONDITIONS

A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

B. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.
1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

C. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials suitable for use intended.
1. Undamaged, previously used materials in serviceable condition may be used.

B. Lumber and Plywood: Comply with requirements in Division 06 Section "Miscellaneous Rough Carpentry".

C. Paint: Comply with requirements of Division 09 Sections "Exterior Painting" and "Interior Painting".

D. Tarpaulins: Provide waterproof, fire resistant, UL labeled tarpaulins with flame spread rating of 15 or less. For temporary enclosures, provide translucent, nylon reinforced, laminated polyethylene or polyvinyl chloride, fire retardant tarpaulins.
1. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mil, minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

E. Water: Provide potable water approved by local health authorities.

F. Chain-Link Fencing: Minimum 2 inch, 0.148 inch thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8 inch O.D. line posts and 2-7/8 inch O.D. corner and pull posts.
1. Plastic construction may be used, where indicated or approved by A/E.

G. Portable Chain-Link Fencing: Minimum 2 inch, 0.148 inch thick, galvanized, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8 inch O.D. line posts and 2-7/8 inch O.D. corner and pull posts, with 1-5/8 inch O.D. top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.

H. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain link fence, sized to height of fence, in color selected by A/E from manufacturer's standard colors.

I. Gypsum Board: Minimum 5/8 inch thick Type “X” panels with tapered edges.

J. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

K. Dust Control Walk-Off Mats: Provide mats minimum 36 by 60 inches.

2.2 EQUIPMENT

A. General: Provide equipment suitable for use intended.
   1. Undamaged, previously used equipment in serviceable condition may be used.

B. Water Hoses: Provide 3/4 inch, heavy duty, abrasion resistant, flexible rubber hoses 100 feet long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.

C. Electrical Outlets: Provide properly configured, NEMA polarized outlets to prevent insertion of 110 to 120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.

D. Electrical Power Cords: Provide grounded extension cords. Use hard service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length voltage ratio.

E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures where exposed to breakage. Provide exterior rated fixtures where exposed to moisture.

F. Heating Equipment: Provide vented, self-contained, liquid propane, natural gas or fuel oil heaters with individual space thermostatic control.
   1. The burners may be fueled with natural gas, liquid propane, or fuel oil, and they should enable the contractor to practically maintain a safe and healthy working environment, with acceptable levels of carbon monoxide. Use of gasoline burning space heaters, open flame heaters, or salamander type heating units is strictly prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
   3. Permanent HVAC System: When A/E and Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at return air grille in system and remove at end of construction.

G. Fire Extinguishers: Provide hand carried, portable, UL rated; Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand carried, portable, UL rated, Class ABC, dry chemical extinguishers or a combination of extinguishers of NFPA recommended classes for the exposures.
   1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

H. Self-Contained Toilet Units: Single occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a high-density polyethylene (HDPE) shell or similar nonabsorbent material.

I. Air Filtration Units: HEPA primary and secondary filter equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

2.3 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owners, A/E, GC, and construction personnel office activities and to accommodate Project meets specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
   1. Furniture required for Project site documents including file cabinets, plan tables, plan racks, and bookcases.
   2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-Vac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4 foot square tack and markerboards.
   3. Drinking water and private toilet.
   4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg. F.
   5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheets sized, furnished, and equipped to accommodate materials and equipment for construction operations.
   1. Store combustible materials apart from building.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections of disposition of salvaged materials that are designated as Owner's property.

B. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the work.

C. Provide each facility ready for use where needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

D. Isolation of Work Areas in Occupied Facilities: prevent dust, fumes, and odors from entering occupied areas.
   1. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with coordination drawings.
      a. Disconnect supply and return ductwork in work areas.
      b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
   2. Maintain dust partitions during the work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
   3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.
   1. Arrange with utility company, Owner, and existing users for a time when service can be interrupted if necessary, to make connections for temporary services.
      a. Where company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.
   2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked in services.
   3. Obtain easements to bring temporary utilities to the Project site where the Owner's easements cannot be used for that purpose.

B. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent offsite in a lawful manner.
   1. Filter out excessive amounts of soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
   2. Connect temporary sewers to the municipal system, where applicable, as directed by sewer department officials.
   3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. Following heavy use, restore normal conditions promptly.
   4. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

C. Water Service and Distribution
   1. The Owner will make provisions for the use of existing water facilities at the Project site and shall designate the location where the service will be provided. GC shall provide means of conveying water from the designated location, as approved by the Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
      a. Sterilization: Sterilize temporary water piping prior to use.
   2. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to eliminate water damage. Drain accumulated water promptly from pans.

D. Temporary Electric Power and Light
   1. The Owner will make provisions for the use of existing service at the Project site and shall designate the location where the service will be provided. GC shall provide own means of extending the electrical service from the designated location, as approved by the Owner, as long as equipment is maintained in a condition acceptable to Owner and does not interfere with Owner's use of the existing building.
      a. Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period.
      b. Should the demolition of any facilities require that power to facilities which are to remain, be interrupted for any duration of time exceeding one hour, provide proper and adequate temporary electrical service to the facilities remaining until such time as permanent service to the remaining facilities can be restored.
      c. Connect temporary service to Owner's existing power source, as directed by Owner.
      d. Refer to General Conditions Article 6.
   2. Should the demolition of existing facilities require that power to facilities which are to remain be interrupted for a duration of time exceeding one hour, the GC for this shall provide proper and adequate temporary electrical service to facilities remaining until such time as permanent service to the remaining facilities can be restored.

E. Heating and Cooling, General: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Provide heating for materials to protect material against injury by frost or freezing and to permit construction to continue in accordance with the approved construction schedule. Select equipment from that specified that would not have a harmful effect on completed installations or elements being installed.
   1. Maintain temperature between 50 degrees F and 80 degrees F in permanently enclosed portions of building for normal construction activities, and a minimum of 65 degrees F for finishing activities and areas where finished work has been installed, unless otherwise required by requirements in technical sections.
   2. Contractor to maintain relative humidity levels to meet product manufacturer's requirements in accordance with project schedule.
      a. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
   3. Maintain a healthy working environment with carbon monoxide levels within OSHA guidelines.
   4. Provide temporary heating or cooling until the A/E confirms that permanent systems of the building are operational unless the Owner and A/E provide an exception.

F. Heating/Cooling System - Existing Building
   1. The existing building heating system shall remain "in-service" throughout construction of the new work.
   2. In the event the existing building heating system is specified to be modified, added to, or replaced in part or total, then the GC shall comply with the requirements hereinafter.
   3. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
      a. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with approved combined coordination drawing and narrative.
         1) Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
         2) Maintain negative air pressure within work area using HEPA-equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
      b. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust containment devices.
      c. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

G. Temporary Heating - Prior to Temporary Enclosure
   1. Until addition is temporarily enclosed, Contractor shall provide temporary heating as required to maintain adequate environmental conditions to facilitate the progress of their particular work activity, to meet specified minimum conditions for the installation and proper curing and/or drying of their materials, and to protect materials and finishes from damage due to temperature (for example, to afford protection of water-bearing material against injury by frost or freezing). Maintain such temporary heating until danger of frost or freezing has past.
      a. Use of gasoline burning space heaters, open flame heaters, or salamanders and electric heaters will not be permitted; however, portable direct -fired heaters, indirect-fired or hydronic fired with LP gas, natural gas, kerosene, #1, or #2 fuel oil will be allowed in accordance only with the "Moisture-Protection Plan" and "Dust-Control and HVAC-Control Plan". When such heaters are employed, the GC shall observe safety precautions necessary; and in no case shall LP gas fired heaters be used in low places of construction, such as pits, tunnels, etc., which can collect heavier than air gas or fumes. Portable heaters must be UL approved.

b. Equipment producing carbon monoxide shall not be used where fumes will contact freshly placed concrete or mortar or create an unhealthy working environment.
c. If direct-fired type heating units are being used, provide temporary dehumidification systems to reduce ambient and moisture levels to avoid potential condensation and to allow installation or application of finishes and there proper curing or drying.

H. Temporary Heating/Cooling - After Temporary or Permanent Enclosure
1. Temporary heating facilities shall have adequate capacity based upon the following:
a. When incorporating special materials into the construction, maintain space temperatures in strict accordance with the manufacturer's instructions.
b. Maintain in heated area not less than 50 degrees F. space temperature.
c. Maintain constantly in heated areas when the space temperature is once raised above 65 degrees F. to prevent thermal shock to the structure.
d. Preheat materials in accordance with manufacturer's instructions and accepted trade practice.
2. After the facility or designated portions thereof have been at a minimum temporarily enclosed and temporary heat is required, the GC shall provide temporary heat using one of the 1 following methods:
a. Method 1 - The Use of a Permanent Heating System
1) The permanent heating system may be used for temporary heating where available and if approved by the GC as ready for operation. If the permanent system is used, the GC shall have installed in their permanent location such fan systems, heating coils, convectors, etc., as approved by the A/E. Provide such controls as are necessary to maintain the temperatures required.
2) Temporary filters shall be used in the permanent system. Provide filter with MERV of 8 at each return air grille in system and remove at end of construction. Provide bases, shields, etc., around heating elements where required to prevent too rapid drying of adjacent concrete, masonry, or plaster. Some of the permanent heating system equipment may require relocation by the GC as required during construction, to prevent interference with continuing construction, where authorized by the A/E. Equipment so used shall be cleaned and restored to new conditions except for ordinary wear, prior to final acceptance, and its use shall in no way negate the Owner's one year warranty specified to commence on the date of Contract Completion.
3) If the permanent system is not fully operable or does not have sufficient controls to maintain the necessary heat in light of existing conditions, the GC shall furnish, install, and maintain temporary units connected to the permanent system. Each unit shall be installed complete with safety controls, venting, power, and fuel connections, room thermostat and necessary ductwork, and piping approved by the A/E. The GC shall remove portions of temporary heating system after they are no longer necessary. The GC shall relocate the temporary heating equipment as required during construction to prevent interference with continuing construction. The GC shall correlate this Work with the other trades involved.
4) In the event of failure to portion of the permanent heating system being used for temporary heat, the GC shall immediately provide other means of temporary heat and shall notify the A/E of the failure. The GC shall immediately make necessary repairs as required to the satisfaction of the A/E.
5) If Method 1 is selected by the GC and approved by the A/E, the start of the warranty on the permanent heating equipment and system(s) will not start until Contract Completion or Final Warranty is issued for complete Work, which means the GC must include costs required for an extended warranty given the above use conditions.

b. Method 2 - The Use of Individual Portable Units
    1) If the permanent system is not fully operable or does not have sufficient controls to maintain the necessary heat in light of existing conditions, the Contractor shall provide, maintain, and supervise the operation of A/E approved direct fired make-up air units, or similar equipment. No electric heat permitted. Utilize natural gas fired units when natural gas is available. Units shall be properly vented, piped, and wired and shall be provided with thermostat for temperature control and with required safety controls.

c. Method 3 – Hydronic Heating System
    1) If permanent system is not operable and the building is enclosed and heating is required, the contractor may furnish and install a temporary low pressure hydronic heating system. The temporary heating system shall consist of an atmospherically vented hydronic heat module utilizing non-hazardous propylene glycol and low pressure fluid flow, placed outside of the structure. The system shall be UL and CSA certified for a heating appliance. System will also provide for individual thermostatically controlled fluid fan coil units for placement inside the structure. Fan coil units shall be UL and CSA certified. Fan coils should have the ability to filter incoming structural air by utilizing MERV 8 replaceable air filters. Fan coils should also be duct able with lay flat ducting on the heat output side.
    2) Furthermore, if necessary, specific explosion proof fan coils UL and CSA certified Class 1 Division 1 Groups C and D, Class II, Division 1 Groups F and G should be utilized if vapors, gases or duct are present inside the structure. Said fan coils will utilize a fluid control valve for temperature control. Also, fan coil will be installed by a journeyman electrician for said hazardous location regulations.
    3) The temporary hydronic heating system will also provide safe, clean and dry heat with zero combustion by-products being introduced into the structure. Hydronic heat systems will provide low humidity and drying capabilities for the structure during the construction process. Hydronic heating system shall provide consistent temperature throughout the entire structure. Data monitoring systems may be utilized to confirm indoor environment requirements for temperature and humidity.
    4) Manufacturer/Product: Quest Climate Control CHH 980 and CHH 300 Hydronic Heating Systems and/or equal may be utilized for temporary construction heating projects.

3. Temporary Cooling: GC shall supply temporary cooling equipment to maintain temperatures below 80 degrees F.
    a. Contractor may utilize the permanent heating/cooling system for temporary cooling when approved by A/E as ready for operation. Otherwise Contractor shall provide independent temporary cooling and dehumidification equipment.
        1) Reheat coils can be utilized to lower relative humidity in air stream.
    b. Independent cooling and dehumidification equipment may be necessary even if permanent system is used if permanent system is not capable of maintaining temperature and humidity required in technical sections.
        1) Permanent system has been design for school operational use and not for temporary construction (drying) purposes.
4. Provide electrical wiring required for temporary heating from temporary electrical service.

I. Ventilation and Humidity Control - After Building Enclosure

1. Provide for ventilation and humidity control of the enclosed space for construction personnel in accordance with applicable laws. Provide ventilation, air conditioning, and humidity control of the enclosed space as required to facilitate drying of gypsum, poured decks and floors, or other materials requiring ventilation in accordance with manufacturer's directions and as required to attain proper moisture levels within building including materials, surfaces and ambient air for installation and application of interior materials and equipment. Provide temporary ventilation and humidity control to protect installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
2. If the permanent ventilation and air conditioning system is approved by A/E for use, the GC shall assume full responsibility for maintenance of the permanent equipment and shall keep the system clean, furnish and change filters as needed, and turn the complete new heating-ventilation system over to the Owner in a clean condition when the project is completed. Permanent equipment shall not be used for temporary ventilation unless maintained and operated as follows:
    a. Return air ducts shall not be used.
    b. Supply air to each unit shall be filtered.
    c. Filters shall be constantly checked and changed when necessary.
    d. Operation of permanent equipment for ventilation shall not negate the Owner's warranty period specified to commence on the date of Contract Completion.
3. Use dehumidification equipment to control environment in space 24 hours a day while joint compounds, paints, flooring, and fireproofing are being installed and until materials in space reach moisture levels as recommended by manufacturers.
    a. Desiccant dehumidifiers shall be of solid desiccant design having a single rotary desiccant wheel capable of fully automatic continuous operation.
    b. Do not re-circulate air through dehumidification equipment unless positive pressure is maintained.

J. Electronic Communication Service: The General Contractor will provide temporary electronic communication service, including electronic mail, in common use facilities. Provide secure Wi-Fi wireless connection to internet with provisions for access by A/E and Owner.

1. Provide a T-1 line, cable or DSL in primary field office.
    a. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 1.0 Mbps upload and 15 Mbps download speeds.
2. Printer: “All-in-one” unit equipped with printer server, combining color printing, photo copying, scanning, and faxing, or separate units for each of these three functions.

K. Sanitary Facilities: The General Contractor will provide, at the beginning of Work, and shall maintain temporary toilets, wash facilities, and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the project's needs.

1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit type privies will not be permitted.
    a. Provide separate facilities for male and female personnel.
3. Drinking Water Facilities: Provide one of the following:
    a. Drinking water fountains including paper cup supply.
    b. Containerized, tap dispenser, bottled water drinking water units, including paper supply.
        1) Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 degrees F.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
   2. Maintain support facilities until Contract Completion or as directed by the A/E.

B. Field Offices and Storage Sheds
   1. Mobile offices or storage facilities may also be supplied by subcontractors for their use under the same conditions, if approved by the Owner and A/E. Remove from and clean premises when directed by Owner and A/E.
      a. Temporary utilities, electrical service, and telephone service shall be provided by GC and subcontractor for their respective construction trailers, offices, work areas, etc., and shall be located in accordance with approved “Use of Site Plan.
      b. As required by the GC due to construction requirements, moving and relocating of trailers and offices will be the responsibility of the subcontractor involved, including costs associated therewith.
   2. Final location of temporary offices shall be as established by "Use of Site Plan," approved by the A/E prior to start of construction.
      a. Locate field offices, storage sheds, and other temporary construction and support facilities for easy access.
   3. GC shall provide storage sheds as required for own use, if approved on “Use of Site Plan”. Install storage and fabrication sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere onsite.
      a. Store combustible materials apart from building.
   4. No signs will be allowed to be erected on the Project site or on the building unless approved by the Owner and A/E.

C. Temporary Roads and Paving
   1. Existing drives and parking areas as indicated on the Drawings and as directed by the Owner and A/E, shall be used as access drives, staging, and parking areas for construction.
      a. Party shall be held responsible for damage to existing surfaces resulting from operations relative to Work being performed under this Contract; and shall repair damaged areas to their original condition, as approved by the A/E, at no additional cost to the Owner.
      b. If there is any right-of-way as identified on Drawings that the Owner is legally responsible to construct and/or maintain, cooperate fully in the construction and/or maintenance of such right of way and avoid interference in use of such right-of-way by others.
   2. Temporary Use of Permanent Roads and Paving Areas: Construct and maintain temporary roads and paving to support the indicated loading adequately and to withstand exposure to traffic during the construction period. Locate temporary paving for roads, storage areas, and parking where the same permanent facilities will be located. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations. Review proposed modifications to permanent paving with the A/E.
      a. Paving: Comply with Division 32 Section “Asphalt Paving” for construction and maintenance of temporary paving.
      b. Coordinate temporary paving development with subgrade grading, compaction, installation, and stabilization of subbase, and installation of base and finish courses of permanent paving.
         1) Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 32 Section “Earth Moving”.
      c. Install temporary paving to rework the installations and to result in permanent roads and paved areas without damage or deterioration when occupied by the Owner.

d. Delay installation of final course of permanent asphalt concrete paving until immediately before Contract Completion. Coordinate with weather conditions to avoid unsatisfactory results.
   1) Recondition base after temporary use, including removing contaminated material, regrading, proofing, compacting, and testing.
e. Extend temporary paving in and around the construction area as necessary to accommodate delivery and storage of materials, equipment usage, administration, and supervision.

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for firefighting equipment and access to fire hydrants.

E. Parking: Use designated areas of Owner's existing parking areas for construction personnel, unless otherwise approved on "Use of Site Plan".

F. Waste Disposal Services (comply with requirements specified in Division 01 Section "Construction Waste Management").
1. GC shall provide (for the life of the project) and pay for dumpster for all trades. Rubbish container shall be adequately sized for the waste, debris, and rubbish generated.
   a. Dispose of container contents weekly or at more frequent intervals if required by inadequate container capacity.
   b. Erect suitable, closed, relatively dust free chutes for the use by all trades during demolition and remodeling. No material or debris will be permitted to drop free.
2. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 degrees F. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.

G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Refer to the Geotechnical report and Division 31 Section "Earthwork" for additional information.
2. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
3. Remove snow and ice as required to minimize accumulation.

H. Temporary Project Identification Signs
1. Project Identification: Prepare project identification and other signs of size indicated. Do not permit installation of unauthorized signs.
   a. The GC shall provide a painted project identification sign, professionally lettered and maintained, giving name of Project, the names and address of the Owner, and A/E. Sign shall be 48 inches by 96 inches with text on both sides.
      1) Face: 3/4-inch thick plywood, exterior type with smooth faces for paint finishes.
      2) Posts and Frame: Preservative treated structural lumber with smooth faces for paint finish.
      3) Finish: Wood primer and enamel finish coat of paint as approved.
   b. The location of the project identification sign shall be as instructed by the A/E or as shown on the Drawings. The size and design shall be in accordance with the A/E's instructions.
      1) Refer to sign sample following this Section.
      2) Install signs where indicated to inform the public and persons seeking entrance to the Project.
   c. Project sign shall be removed when instructed by the A/E or prior to completion and final acceptance, unless instructed by the A/E to be left on the site longer, in which case the Owner will remove it.

2. Temporary Signs: Provide other signs as indicted and as required to inform public and individuals seeking entrance to the Project.
    a. Provide temporary, directional signs for construction personnel and visitors.
3. Maintain and touch up signs, so they are legible at all times.

I. Openings for Electrical, Mechanical, and Other Trades
1. Temporary openings not called for on the Drawings, which may be required for the purpose of bringing equipment into the buildings or for placing same, shall be performed as approved by the A/E and GC. Perform the Work of providing and maintaining such openings and of restoring the structure.

J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered “tools and equipment” and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and an adjacent property, except those indicated to be removed or altered. Repair damage to existing facilities.
1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access properly for that purpose.

B. Temporary Enclosures
1. Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
    a. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
        1) Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
    b. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 square feet or less with plywood or similar materials.
        1) Where temporary wood or plywood enclosure exceeds 100 square feet in area, use UL labeled, fire retardant treated material for framing and main sheathing.
    c. Close openings through floor or roof decks and horizontal surfaces with load bearing, wood framed construction.

C. Temporary Egress: Maintain temporary egress and exist ways for protection of life and property as required by authorities having jurisdiction.

D. Site Enclosure Fencing: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site.
1. The General Contractor will install construction fencing in accordance with the “Use of Site Plan” and around temporary structures, storage areas, roadways, and other hazards as required for safety and security.
    a. Chain Link Fencing: Unless otherwise noted, provide chain link fencing.
    b. Plastic Construction Fencing: Provide only where approved by A/E on “Use of Site Plan”.
    c. The GC shall remove fencing if necessary due to construction progress when directed by the A/E.

E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
   1. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant treated plywood.
      a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain walk-off mats in vestibule and at each entrance through temporary partition.
   2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
   3. Insulate partitions to control noise transmission to occupied areas.
   4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
   5. Protect air-handling equipment.

F. Temporary First Aid Facilities: Applicable provisions of federal, state, county, and municipal regulations for construction safety in the State in which the Project is located shall govern these Construction Documents and the Construction hereby contemplated.

G. Temporary Fire Protection: Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 “Standard for Portable Fire Extinguishers” and NFPA 241 “Standard for Safeguarding Construction, Alterations, and Demolition Operations.”
   1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
      a. Minimum provisions, unless otherwise required by law(s), shall be 10# capacity ABC type fire extinguishers, plainly marked and easily accessible, in each area where work is in progress.
      b. Provide wood standards for fire extinguishers and emergency alarm stations. The 2 by 3 foot plywood panel shall be painted green. The base shall be painted red.
   2. Store combustible materials in containers in fire safe locations.
   3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.
      a. Use of open flames is prohibited.
   4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
   5. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other sections.
   6. Develop and supervise an overall fire-prevention and protection program for personnel at Project site. Provide temporary emergency systems, warning systems, and fire alarm systems in accordance with OSHA standards. Contractor to provide alarm stations consisting of an area plan showing alarm station locations, escape routes to nearby exits, and a distinctive alarm capable of being heard above ambient noise levels. Remove temporary systems after permanent systems are operational.
   7. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.
   8. Permanent Fire Protection: At the earliest feasible date in each area of the Project, complete installation of the permanent fire protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
   9. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are preformed close to sprinklers, shield them temporarily with guards.
      a. Remove temporary guards at end of work shifts, whenever operations are paused, and when nearby work is complete.
      b. Provide fire watch when the sprinkler system is offline during upgrades.

H. Environmental Protection
   1. In order to prevent and to provide for abatement and control of environmental pollution arising from the construction activities in the performance of this Contract, comply with applicable federal, state, county, and municipal laws, and regulations concerning environmental pollution control and abatement as well as the specific requirements stated elsewhere in the Contract Documents.
   2. Items having apparent historical or archaeological interest that are discovered in the course of construction activities shall be carefully preserved. Leave the archaeological find undisturbed and shall immediately report the find to the A/E so that the proper authorities may be notified.
   3. Do not pollute water resources with fuels, oils, bitumen, calcium chloride, acids or harmful materials. Investigate and comply with applicable federal, state, county, and municipal laws concerning pollution of rivers and streams. Work under this Contract shall be performed in such a manner that objectionable conditions will not be created in water resources through or adjacent to the Project areas.
      a. Spillages: Throughout the duration of the Project, special measures shall be taken to prevent chemicals, fuels, oils, grease, bituminous materials, waste washings, herbicides and insecticides, and cement from entering water resources.
      b. Disposal: If waste material is dumped in unauthorized areas, remove the material and restore the area to the condition of the adjacent undisturbed area. If necessary, contaminated ground shall be excavated, disposed of as directed by the A/E, and replaced with suitable fill material, compacted and finished with topsoil.
   4. Minimize dispersed dust at required excavations, embankments, stockpiles, haul roads, permanent access roads, plant sites, waste areas, borrow areas, and other work areas on or off site to minimize dispersed dust.
   5. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Division 31 Section “Site Clearing”.
      a. The GC shall be relieved of responsibilities associated with being the Co-Permittee for the Construction General Permit at the point in time when their work is Substantially Complete and can be transferred to party responsible for next contract.
   6. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
      a. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree or plant protection zones.
      b. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
      c. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from the Project site during the course of the Project.
      d. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

I. Security Enclosure and Lockup
   1. Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
      a. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of materials to minimize the opportunity for theft and vandalism.
   2. Provide temporary doors and closures.
      a. Provide hinged plywood or batten doors with locks to maintain temperatures necessary to perform the Work and provide temporary building security.

b. Permanent closures of openings may be installed, provided that these are protected and are left in perfect condition when building is completed. Where required, closures shall be of a material or type that will permit passage of air for ventilation to dry out building.

3. Relocate as required by progress of construction, by storage or work requirements, and to accommodate legitimate requirements of Owner and other Contractors employed at the site, if applicable. Completely remove when construction needs can be met by use of permanent construction. Clean and repair damage caused by installation or by use.

J. Existing Utility Protection
1. Existing utility lines and structures indicated or known, and utility lines constructed for this Project shall be protected from damage during construction operations.
2. Locate and flag lines and structures before beginning excavation and other construction operations.
3. When utility lines and structures that are to be removed or relocated are encountered within the area of operations, notify the A/E and affected utility in ample time for the necessary measures to be taken to prevent interruption of the services.
4. Damage to existing utility lines or structures not indicated or known shall be reported immediately to the A/E and the affected utility.

K. Storm Water Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of storm water from heavy rains.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed work, and replacing water-damaged work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary cooling equipment; reheat coils and/or dehumidification to control humidity or permanent heating/cooling system when approved by A/E.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24 hour basis where required to achieve indicated results and to avoid possibility of damage.
2. Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are the property of GC.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 01 Section “Closeout Procedures”.

END OF SECTION 01 50 00

SECTION 01 57 19 – INDOOR AIR QUALITY (IAQ) MANAGEMENT
(During Construction)

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes special requirements for Indoor Air Quality (IAQ) management during construction operations.
   1. Control of emissions during construction.
   2. Control of moisture during construction.

B. Procedures for testing baseline IAQ. Baseline IAQ requirements specify maximum indoor pollutant concentrations for acceptance of the facility.

C. Related Sections:
   1. Division 01 Section “Indoor Air Quality Requirements (Before Occupancy).

1.2 DEFINITIONS

A. Adequate ventilation: Ventilation, including air circulation and air changes, required to cure materials, dissipate humidity, and prevent accumulation of particulates, dust, fumes, vapors, or gases.

B. Hazardous Materials: Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261. Throughout this specification, hazardous material includes hazardous chemicals.
   1. Hazardous materials include: pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC).

C. Indoor Air Quality (IAQ): The composition and characteristics of the air in an enclosed space that affect the occupants of that space. The indoor air quality of a space refers to the relative quality of air in a building with respect to contaminants and hazards and is determined by the level of indoor air pollution and other characteristics of the air, including those that impact thermal comfort such as air temperature, relative humidity and air speed.

D. Interior final finishes: Materials and products applied within the vapor barrier of the building that will be exposed at interior, occupied spaces; including (but not limited to) flooring, wallcovering, finish carpentry, and ceilings.

E. Packaged dry products: Materials and products that are installed in dry form and are delivered to the Project site in manufacturer's packaging; including carpets, resilient flooring, ceiling tiles, and insulation.

F. Wet products: Materials and products installed in wet form, including paints, sealants, adhesives, special coatings, and other materials which require curing.

1.3 PERFORMANCE REQUIREMENTS

A. During Construction: Reduce indoor air quality problems resulting from the construction/renovation process in order to help sustain the comfort and well being of construction workers and building occupants.

B. Adopt an IAQ management plan to protect the HVAC system during construction, control pollutant sources and interrupt contamination pathways. Sequence the installation of materials to avoid contamination of absorptive materials such as insulation, carpeting, ceiling tile and gypsum wallboard.

1.4 INFORMATIONAL SUBMITTALS

A. Indoor Air Quality (IAQ) Management Plan: Not less than 10 business days before the Pre-construction meeting, prepare and submit an IAQ Management Plan including, but not limited to, the following:
   1. During construction meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction Second Edition – November 2007 Chapter 3.
   2. Protect stored on-site or installed absorptive materials from moisture damage.
   3. In the [unlikely] event that the Owner authorizes the use of permanently installed air handlers for temporary use during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 shall be used at each return air grille, as determined by ASHRAE 52.2 – 1999. Replace all filtration media immediately prior to occupancy.
   4. Prohibit smoking inside the building and within 25 feet of building entrances once building is closed.
   5. Revise and resubmit IAQ Management Plan as required by General Contractor.
      a. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.

B. Product Data: Submit product data for filtration media to be used during construction and prior to occupancy. Include Minimum Efficiency Reporting Value (MERV).

C. Provide six photographs of 6 locations on three different occasions during construction along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: When furnishing closeout submittals for the following products, include Material Safety Data Sheets (MSDSs) – but only within final operation and maintenance manuals.
   1. Floor and wall patching/leveling materials.
   2. Caulking and sealants.
   3. Insulating materials.
   4. Concrete curing compounds.
   5. Sprayed-on fireproofing.
   6. Carpet.
   7. Paints and Coatings.
   8. Clear finish for wood surfaces.
   9. Lubricants.
   10. Cleaning products.

1.6 QUALITY ASSURANCE

A. Pre-construction meeting – As part of the Pre-construction meeting, discuss the proposed IAQ Management Plan and to develop mutual understanding relative to details of environmental protection. Record discussions and agreements and furnish copy to each participant. Provide at least 72 hours' advance notice to participants before holding the Pre-construction meeting.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 IAQ MANAGEMENT – EMISSIONS CONTROL

A. During construction operations, follow the recommendations in SMACNA IAQ Guidelines for Occupied Buildings under Construction, 1995, Chapter 3.

B. HVAC Protection:
1. Seal return registers during construction operations.
2. Provide temporary exhaust during construction operations.
3. To the greatest extent possible, isolate and/or shut down the return side of the HVAC system during construction. When ventilation system must be operational during construction activities, provide MERV 8 or greater temporary filtration on all return air grilles.

C. Source Control: Provide materials and products with low pollutant emissions as specified.
1. Potential sources of Volatile Organic Compound (VOC) emissions include the following:
a. Paints, stains, and varnishes.
b. Solvents.
c. Adhesives and wood preservatives.
d. Waxes, polishes, and cleansers.
e. Lubricants and sealants.
f. Fuels.
g. Plastics.
2. Potential sources of Combustion Contaminants include the following:
a. Furnaces and generators.
b. Gas or kerosene space heaters.
c. Tobacco products.
d. Vehicles.
3. Potential sources of Formaldehyde Contaminants include the following:
a. Particle board and plywood.
b. Cabinetry.
c. Insulation.
4. Potential sources of Particle and Fiber Contaminants include the following:
a. Paper printing and handling.
b. Insulation.
c. Vacuuming and cleaning of construction areas.
5. Pathway Interruption: Isolate areas of work as necessary to prevent contamination of clean or occupied spaces. Provide pressure differentials and/or physical barriers to protect clean or occupied spaces.
6. Housekeeping: During construction, maintain project and building products and systems to prevent contamination of building spaces.
7. Temporary Ventilation: Provide an ACH (air changes per hour) of 1.5 or more and as follows:
a. Provide pre-ventilation of packaged dry products prior to installation per manufacturing requirements. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant sources and residues. Do not ventilate within limits of Work unless otherwise approved by Architect.
b. Provide adequate ventilation during and after installation of interior wet products and interior finishes.
c. Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2 during construction. Coordinate with work of Division 23, Heating Ventilating and Air Conditioning (HVAC).

D. Scheduling: Schedule construction operations involving wet products prior to packaged dry products to the greatest extent possible.

3.2 IAQ MANAGEMENT – MOISTURE CONTROL

1. Housekeeping:
   a. Keep materials dry. Protect stored on-site and installed absorptive materials from moisture damage.
   b. Verify that installed materials and products are dry prior to sealing and weatherproofing the building envelope.
   c. Install interior absorptive materials only after building envelope is sealed and weatherproofed.
2. Schedule:
   a. Weather-proof as quickly as possible. Schedule installation of moisture-control materials, including but not limited to air barriers, flashing, exterior sealants and roofing, at the earliest possible time.
   b. Schedule work such that absorptive materials, including but not limited to porous insulations, paper-faced gypsum board, ceiling tile, and finish flooring, are not installed until they can be protected from rain and construction-related water.

END OF SECTION 01 57 19

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
      a. Anchor bolt location survey.
   3. General installation of products.
   4. Starting and adjusting.
   5. Protection of installed construction.

B. Related Sections include the following:
   1. Division 01 Section “Summary” for coordination of Owner-furnished products and limits on use of Project sites.
   2. Division 01 Section "Submittal Procedures" for submitting surveys.
   3. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
   4. Division 01 Section “Progress Cleaning” for progress cleaning.
   5. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 PREINSTALLATION MEETINGS

A. Layout Conference: Conduct conference at Project site.
   1. Prior to establishing layout of new perimeter and structural column grids, review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform A/E of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:
      a. Contractor’s superintendent
      b. Professional surveyor or Professional engineer.
      c. Professional surveyor or Professional engineer responsible for performing site survey as basis of Project Design.
   2. Review meetings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
   3. Review requirements for including layouts on shop drawings and other submittals.
   4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Informational/Quality Assurance/Control Submittals:
   1. Qualification Data: For land surveyor or professional engineer.
   2. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
   3. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this project in material, design, and extent.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturers written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
   1. Before construction:
      a. Verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water service piping.
      b. Verify the location of underground electrical services, natural gas piping and other utilities.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Examination and Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

D. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
   1. Description of the Work.
   2. List of detrimental conditions, including substrates.
   3. List of unacceptable installation tolerances.
      a. Recommended corrections.

E. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner and A/E that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a Request for Interpretation to A/E. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

E. Protect roof areas where construction traffic is anticipated.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify A/E promptly.
   1. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction. Do not change or relocate benchmarks or control points without prior written approval. Promptly report lost or destroyed reference points or requirements to relocate reference points because of necessary changes in grades or locations.
   2. Promptly replace lost or destroyed project control points. Base replacements on the original survey control points.

B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
   1. Establish a minimum of 2 permanent benchmarks and control points to set lines and levels and elsewhere as needed to locate each element of Project.
   2. Establish limits on use of Project Site.
   3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   4. Inform installers of lines and levels to which they must comply.
   5. Check the location, level and plumb, of every major element as the Work progresses.
   6. Notify A/E when deviations from required lines and levels exceed allowable tolerances.
   7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by A/E.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. Do not change or relocate existing benchmarks or control points without prior written approval of A/E. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to A/E before proceeding.
   2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of 2 permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
   2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
   3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
   1. Anchor Bolt Survey Location: On completion of anchor bolt installation and prior to erecting steel, prepare a certified survey showing dimensions, locations, angles, and elevation of anchor bolts.

3.5 INSTALLATION, GENERAL

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
   4. Maintain minimum headroom clearance of 8 feet occupied spaces and 90 inches in unoccupied spaces, unless indicated on drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Contract Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at height directed by A/E.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
   4. Electrical wiring and associated metallic conduit shall not be embedded within roof assemblies or placed directly below roof decks. Electrical wiring or metallic conduit located near roof assemblies shall be positioned and supported at least 10 inches away from the bottom side of the metal roof deck or other substrate to which a roof system has been or will be applied.
   5. Suspension wires, straps, chains, and metal framing such as those used to support the following shall not be attached to or through steel roof decks.
      a. Bulkheads.
      b. Suspended ceilings.
      c. Fire-suppression systems.
      d. Ductwork.
      e. Lighting.
      f. Similar items.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Inspect field-assembled components and equipment installation. Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Contract Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

D. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
   1. Protect new roof areas where continued construction traffic is anticipated.
      a. Loosely lay 1-inch minimum thick, molded expanded polystyrene (MEPS) insulation over the roofing membrane in areas indicated. Loosely lay 15/32-inch plywood or OSB panels over MEPS. Extend MEPS past edges of plywood or OSB panels a minimum of 1 inch.
         1) Protection sheet or mat: provide a sacrificial layer of matching membrane sheet extending minimum 6 inches beyond insulation in all directions or a woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.
      b. Limit traffic and material storage to areas or roofing that have been protected.

3.8 CORRECTION OF WORK

A. Repair or remove and replace damaged, defective, or nonconforming work. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with watching materials, and properly adjusting operating equipment.

B. Repair work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:
   1. Division 02 Section "Selective Structure Demolition" for demolition of selected portions of the building.
   2. Divisions 02 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
   3. Division 07 Section "Penetration Firestopping" for patching fire-rated construction.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

C. Cutting and patching performed during the manufacture of products or during the initial fabrication, erection, or installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners and similar operations are also not considered to be "cutting and patching".

1.3 QUALITY ASSURANCE

A. Structural Elements:
   1. When cutting and patching structural elements, notify A/E of locations and details of cutting and await directions from the A/E before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
   2. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
      a. Foundation construction.
      b. Bearing and retaining walls.
      c. Structural concrete.
      d. Structural steel.
      e. Lintels.
      f. Structural decking.
      g. Miscellaneous structural metals.
      h. Exterior curtainwall construction.
      i. Equipment supports.
      j. Piping, ductwork, vessels, and equipment.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include the following:
   1. Primary operational systems and equipment.
   2. Fire-resistance-rated construction.
   3. Partitions that enclose incidental use areas – that are not required to be fire-resistance-rated due to the presence of automatic fire-extinguishing systems – but are still required to resist the passage of smoke.
   4. Air barriers.
   5. Fire-suppression systems.

6. Control systems.
7. Communication systems.
8. Conveying systems.
9. Fire detection and alarm systems.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
1. Membranes and flashings.
2. Equipment supports.
3. Noise- and vibration-control elements and systems.
4. Sprayed fire-resistive material.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in A/E's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

E. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.4 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

B. Temporary Support: Provide temporary support of Work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Division 01 Section "Summary."

E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
   2. Do not use cutting torches.
   3. No cutting that may impair the strength of the building or its components. No holes except for small screws or bolts may be drilled in the beams or other structural members for the purpose of supporting, routing, or attaching Work without obtaining prior approval from the A/E.
      a. Provide temporary support of work to be cut.
   4. Refer to other Sections of these Specifications for specific cutting and patching requirements and limitations applicable to individual units of Work.
   5. Unless otherwise specified, requirements of this Section apply to Mechanical and Electrical Work.
      a. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
      a. After coring, pack and grout openings around sleeves or Work penetrating the floor or deck.
      b. CMU Removal: Remove units that are damaged or require removal to accommodate new work. Carefully remove entire units joint to joint, without damaging surrounding masonry in a manner that permits replacement with full size units.
         1) Support and protect remaining masonry that surrounds removal area. Maintain reinforcement and adjoining construction in an undamaged condition.
         2) Clean surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.
   4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching only after other nearby construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
    b. Patch Floor: Mix and apply underlayment components according to manufacturer's written instructions.
        1) Close areas to traffic during underlayment and for time period after application recommended in writing by manufacturer.
        2) Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
        3) At substrate expansion, isolation, and other moving joints, allow joint of same width to continue underlayment.
        4) Apply primer over prepared substrate at manufacturer's recommended spreading rate.
        5) Apply underlayment to a uniform, level surface.
            a) Apply a final layer without aggregate to produce surface.
            b) Feather edges to match adjacent floor elevations.
        6) Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
        7) Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
        8) Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.
    c. Patch CMU: Replace damaged or removed units into bonding and coursing pattern of existing. Lay replacement units with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
    a. Cut, patch, and repair plaster as necessary to accommodate new work and to restore to match adjacent undisturbed surfaces. Repair or replace work to eliminate evidence of new work.
    b. Refer to Division 09 Section "Acoustical Panel Ceilings" for replacement of acoustical ceilings.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01 73 29

SECTION 01 74 00 – PROGRESS CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes cleaning requirements during construction operations.

B. Related Work
   1. Division 00 Document “General Conditions” (Article 6).
   2. Division 01 Section “Indoor Air Quality Management”.
   3. Division 01 Section "Closeout Procedures" for requirements for final cleaning.

1.2 RUBBISH CONTAINMENT

A. Refer to Division 01 Section “Temporary Facilities and Controls” and Division 01 Section "Construction Waste Management and Disposal" for requirements.

1.3 SAFETY REQUIREMENTS

A. Hazards Control
   1. Store volatile wastes in covered metal containers and remove from premises daily.
   2. Prevent accumulation of wastes that create hazardous conditions.
   3. Provide adequate ventilation during use of volatile or noxious substances.

B. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
   1. Do not burn or bury rubbish and waste materials on project site.
   2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
   3. Do not dispose of wastes into streams or waterways.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use only cleaning materials recommended by manufacturer of surface to be cleaned.
   1. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finish surface.

B. Utilize nontoxic cleaning materials and methods.
   1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.
   2. Use natural cleaning materials where feasible. Natural cleaning materials include:
      a. Abrasive Cleaners: Substitute 1/2 lemon dipped in borax.
      b. Ammonia: Substitute vinegar, salt and water mixture or baking soda and water.
      c. Disinfectants: Substitute 1/2 cup borax in gallon of water.
      d. Drain Cleaners: Substitute 1/4 cup baking soda and 1/4 cup vinegar in boiling water.
      e. Upholstery Cleaners: Substitute dry cornstarch.

PART 3 - EXECUTION

3.1 DAILY/PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
      a. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

K. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted or finished surfaces.

3.2 ROUTINE CLEANING

A. Employ experienced workers for cleaning.

B. Remove dirt, mud, and other foreign materials from sight exposed interior and exterior surfaces.

C. Weekly, or at more frequent intervals, if work activities justify same, perform the following cleaning. This includes all dirt, dust, and debris not identifiable as part of a Contract. Broom clean floor and paved surfaces; rake clean other surfaces of ground.

D. Maintain cleaning throughout the duration of the Project.

E. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.

END OF SECTION 01 74 00

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Substantial Completion Inspection.
   2. Final Contract Completion.
   3. Warranties.
   4. Final cleaning.
   5. Repair of work.

B. Related Sections include the following:
   1. Division 01 Section “Submittal Procedures” for submission of closeout document procedures.
   2. Division 01 Section "Construction Cleaning" for progress cleaning of Project site.
   3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   4. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   5. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
   6. Division 01 Section “Indoor Air Quality Requirements”.
   7. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor’s List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at final completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 PREREQUISITIES TO SUBSTANTIAL COMPLETION INSPECTION

A. Preliminary Procedures: Before requesting inspection for determining date of complete the following.
   1. Final Cleaning: Refer to Division 00 Document “General Conditions” (Article 6.25).
   2. GC’s Punch List: Refer to Division 00 Document “General Conditions” (Article 6.26).

1.6 PREREQUISTIES TO CONTRACT COMPLETION

A. Request a final inspection by A/E when all “Punch List Items” have been completed. Final inspection shall occur within 30 days of issuance of Substantial Completion.

1. GC shall indicate any items to be deferred in request.
2. Final punch list shall be checked and signed off by Contractor.

B. Reinspection: A/E will reinspect work and if items have been completed and record documents have been received, A/E will process a Certificate of Contract Completion.

C. WSU Affidavit of Prevailing Wage from signed and notarized for contractor and each subcontractor employed on Project.
1. Original copy of each form shall be submitted.

1.7 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner’s rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
1. Submit on digital media acceptable to Owner and A/E.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
1. Utilize non-toxic cleaning materials and methods.
a. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.
2. Utilize natural cleaning materials where feasible. Natural cleaning materials include:
a. Abrasive cleaners: Substitute 1/2 lemon dipped in borax.
b. Ammonia: Substitute vinegar, salt and water mixture, or baking soda and water.
c. Disinfectants: Substitute 1/2 cup borax in gallon of water.
d. Drain Cleaners: Substitute 1/2 cup baking soda with 1/4 cup vinegar in boiling water.
e. Upholstery Cleaners: Substitute dry cornstarch.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
1. Refer to Article 6 of the General Conditions.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particular matter on inspection.
    1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Contract Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    a. Do not paint over “UL” and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory manuals.
   2. Emergency manuals.
   3. Systems and equipment operation manuals.
   4. Systems and equipment maintenance manuals.
   5. Product maintenance manuals.

B. Related Requirements:
   1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Division 01 Section “Closeout Procedures” for administrative and procedural requirements, including warranties.
   3. Division 01 Section “Project Record Documents” for preparing Record Drawings for operation and maintenance manuals.
   4. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the work of those Sections.

1.2 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals as indicated in individual specification sections and as reviewed and approved at the time of Section submittals.
   1. A/E will comment on whether content of operation and maintenance submittals is acceptable.
   2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:
   1. Submit on digital media acceptable to A/E. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: To facilitate the Closeout Process, the GC shall submit the scope of items to be submitted in the form of an expanded Table of Contents to A/E, for review. Submit at least 30 days before commencing demonstration and training begins.
   1. If the project is being constructed in Phases, provide Maintenance and Operating Manuals at the completion of each Phase of Work.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. A/E will return copy with comments.
   1. Correct or revise each manual to comply with A/E's comments. Submit copies of each corrected manual within 15 days of receipt of A/E's comments and prior to commencing demonstration and training.

E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.
   1. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

F. Additional Requirements:
   1. Training is required for all equipment installed for SWU maintenance personnel.
   2. For no-equipment installations, Contractor shall schedule a walk through with WSU at the end of Project to show location of valves, electrical work, etc.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
   1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
   2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.
   3. Manual contents.

B. Title Page: Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name and contact information for General Contractor.
   6. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
   7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
   1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
   2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
   3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.7 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:
   1. Type of emergency.
   2. Emergency instructions.
   3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
   1. Fire.
   2. Flood.
   3. Gas leak.
   4. Water leak.
   5. Power failure.
   6. Water outage.
   7. System, subsystem, or equipment failure.
   8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.

2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
   1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
      a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
   1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Color, pattern, and texture.
   4. Material and chemical composition.
   5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
   1. Inspection procedures.
   2. Types of cleaning agents to be used and methods of cleaning.
   3. List of cleaning agents and methods of cleaning detrimental to product.
   4. Schedule for routine cleaning and maintenance.
   5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents.

B. Related Sections include the following:
   1. Division 01 Section "Closeout Procedures" for general closeout procedures.
   2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings (As-Built Drawings): Comply with the following:
   1. Number of Copies: Submit one set of marked-up Record Prints to the A/E with associated BIM file updates.

PART 2 - PRODUCTS

2.1 PROJECT RECORD DOCUMENTS

A. Record Documents, General
   1. Maintain at the jobsite one copy of Drawings, Project Manual, addenda, final shop drawings, change orders, field orders, other contract modifications, and other documents in compliance with various Sections of the Project Manual.

B. Record Drawings
   1. Maintain "As-Built Drawings" on separate xerographic prints set-aside especially for this purpose on the job. Drawings shall incorporate changes made in the Work of the respective trades during the construction period. Such changes shall be indicated at the time they occur.
      a. Accurately record information in an understandable drawing technique.
      b. Record data as soon as possible after obtaining it. Record and check markup prior to enclosing concealed installations.
   2. Each of these drawings shall be clearly marked "As-Built Drawings"; maintained in good condition; available for observation by A/E; and shall not be used for construction purposes. Mark these drawings to show the actual installation where the installation varies from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include, but are not limited to, the following:
      a. Dimensional changes to the Drawings.
      b. Significant detail not shown in the original Contract Documents including Change Orders or Change Directives.
      c. The location of underground utilities and appurtenances dimensionally referenced to permanent surface improvements.
      d. The location of internal utilities and appurtenances concealed in building structures, referenced to visible and accessible features of the structures.
      e. When elements are placed exactly as shown on Drawings, so indicate; otherwise show changed location.
      f. Revisions to details shown on the Drawings.
      g. Depths of foundations below the first floor.
      h. Revisions to routing of piping and conduits.
      i. Revisions to electrical circuiting.

j. Actual equipment locations.
k. Duct size and routing.
l. Details not on original Contract Drawings.

3. Keep project drawings current. Do not permanently conceal work until the required information has been recorded. Mark record prints of Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where shop drawings are marked, show cross-reference on Drawings location.
   a. Mark record sets with red, or color that may be photo copied, erasable colored pencil. Use other colors (no blue) to distinguish between changes for different categories of the work at the same location.
   b. Note Change Directives, alternate numbers, change order numbers, and similar identification.
4. Prior to request for certificate of Contract Completion, organize the "As-Built Drawings" into manageable sets, bind the sets with durable paper cover sheets, certify to the accuracy of the "As-Built Drawings" by signature thereon, and deliver the "As-Built Drawings" to the A/E.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for A/E's reference during normal working hours.

C. At conclusion of Project 100% complete project manuals containing all shop drawings, samples, training information, warranties, etc., as required by front end sections are required by Owner.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Full cooperation during the Owner’s audio- and video-recording of demonstration and training sessions.

B. Related Sections:
   1. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit 2 copies of outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

A. At completion of training, submit one complete training manual for Owner’s use.

B. Pre-Produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by A/E.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if subcontractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.
      e. Equipment function.
      f. Operating characteristics.
      g. Limiting conditions.
      h. Performance curves.
   2. Documentation: Review the following items in detail:
      a. Emergency manuals.
      b. Operations manuals.
      c. Maintenance manuals.
      d. Project record documents.
      e. Identification systems.
      f. Warranties and bonds.
      g. Maintenance service agreements and similar continuing commitments.
   3. Emergencies: Include the following, as applicable:
      a. Instructions on meaning of warnings, trouble indications, and error messages.
      b. Instructions on stopping.
      c. Shutdown instructions for each type of emergency.
      d. Operating instructions for conditions outside of normal operating limits.
      e. Sequences for electric or electronic systems.
      f. Special operating instructions and procedures.
   4. Operations: Include the following, as applicable:
      a. Startup procedures.
      b. Equipment or system break-in procedures.
      c. Routine and normal operating instructions.
      d. Regulation and control procedures.
      e. Control sequences.
      f. Safety procedures.
      g. Instructions on stopping.
      h. Normal shutdown instructions.
      i. Operating procedures for emergencies.
      j. Operating procedures for system, subsystem, or equipment failure.
      k. Seasonal and weekend operating instructions.
      l. Required sequences for electric or electronic systems.
      m. Special operating instructions and procedures.
   5. Adjustments: Include the following:
      a. Alignments.
      b. Checking adjustments.
      c. Noise and vibration adjustments.
      d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
    a. Diagnostic instructions.
    b. Test and inspection procedures.
7. Maintenance: Include the following:
    a. Inspection procedures.
    b. Types of cleaning agents to be used and methods of cleaning.
    c. List of cleaning agents and methods of cleaning detrimental to product.
    d. Procedures for routine cleaning
    e. Procedures for preventive maintenance.
    f. Procedures for routine maintenance.
    g. Instruction on use of special tools.
8. Repairs: Include the following:
    a. Diagnosis instructions.
    b. Repair instructions.
    c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    d. Instructions for identifying parts and components.
    e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between subcontractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
    1. Owner will furnish subcontractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
    1. Schedule training with Owner, through GC, with at least fourteen days' advance notice.

D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 AUDIO- AND VIDEO-RECORDING OF DEMONSTRATION AND TRAINING

A. General: Owner may engage a photographer or sound technician to audio- or video-record demonstration and training sessions.

B. Subcontractor and trainer shall cooperate fully with the Owner’s efforts to audio- or video-record demonstration and training sessions.

END OF SECTION 01 79 00

SECTION 01 81 19 - INDOOR AIR QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Sections Includes: Administrative and procedural requirements governing specifications for achieving indoor air quality (IAQ) objectives for the project.
   1. Construction Indoor Air Quality Management Plan Intent: To promote the well-being of construction workers and building occupants by minimizing indoor air quality problems associated with construction.
   2. Indoor Air Quality Assessment Intent: To establish better quality indoor air in the building after construction and during occupancy.

B. Related Sections: The following sections contain requirements that relate to this section:
   1. Division 01 Section “Temporary Facilities and Controls” for temporary requirements.

1.2 REFERENCES

A. Sheet Metal and Air-Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd edition, 2007, ANSI/SMACNA 008-2008 (Chapter 3): smacna.org.

B. ASHRAE 52.2-2007: ashrae.org.

C. ASTM D5197-09e1 Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology): astm.org/Standards/D5197.htm.

D. ASTM D5149-02 (2008) Standard Test Method for Ozone in the Atmosphere: Continuous Measurement by Ethylene Chemiluminescence: astm.org/Standards/D5149.

E. ISO 16000-3, Indoor air–Part 3: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air – Active sampling method: iso.org/ISO/home/store/catalogue_tc/catalogue_detail.htm?csnumber=51812.

F. ISO 16000-6, Indoor air–Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS or MS-FID: iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=52213.

G. ISO 4224 Ambient air–Determination of carbon monoxide-Nondispersive infrared spectrometric method: iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=32229.

H. ISO 7708 Air quality-Particle size fraction definitions for health-related sampling: iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=14534.

I. ISO 13964 Air quality-Determination of ozone in ambient air-Ultraviolet photometric method: iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=23528.

J. U.S. EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air, IP-1: Volatile Organic Compounds, IP-3: Carbon Monoxide and Carbon Dioxide, IP-6: Formaldehyde and other aldehydes/ketones, IP-10 Volatile Organic Compounds: nepis.epa.gov.

K. U.S. EPA Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air, TO-1: Volatile Organic Compounds, TO-11: Formaldehyde, TO-15: Volatile Organic Compounds, TO-17.

L. Volatile Organic Compounds: epa-gov/ttnamth/airtox.html.

M. California Department of Public Health, Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers, v1.1-2010: cal-laq.org/separator/voc/standard-method.

1.3 DEFINITIONS

A. Adequate ventilation: Ventilation, including air circulation and air changes, required to cure materials, dissipate humidity, and prevent accumulation of particulates, dust, fumes, vapors, or gases.

B. Hazardous Materials: Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261. Throughout this specification, hazardous material includes hazardous chemicals.
   1. Hazardous materials include: pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC).

C. Indoor Air Quality (IAQ): The composition and characteristics of the air in an enclosed space that affect the occupants of that space. The indoor air quality of a space refers to the relative quality of air in a building with respect to contaminants and hazards and is determined by the level of indoor air pollution and other characteristics of the air, including those that impact thermal comfort such as air temperature, relative humidity and air speed.

D. Interior final finishes: Materials and products applied within the vapor barrier of the building that will be exposed at interior, occupied spaces; including (but not limited to) flooring, wallcovering, finish carpentry, and ceilings.

E. Packaged dry products: Materials and products that are installed in dry form and are delivered to the Project site in manufacturer's packaging; including carpets, resilient flooring, ceiling tiles, and insulation.

F. Wet products: Materials and products installed in wet form, including paints, sealants, adhesives, special coatings, and other materials which require curing.

G. Absorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.

H. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.

I. Particulates: Dust, dirt and other airborne solid matter.

J. Wet Work: Concrete, plaster, coatings, and other product that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.4 REQUIREMENTS

A. Construction Indoor Air Quality Management Plan: Develop and implement an indoor air quality (IAQ) management plan for the construction and preoccupancy phases of the building. The plan must address the following:
   1. During construction, meet or exceed all applicable recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd edition, 2007, ANSI/SMACNA 008-2008, Chapter 3.
   2. Protect absorptive materials stored on-site and installed from moisture damage.
   3. Do not operate permanently installed air-handling equipment during construction unless filtration media with a minimum efficiency reporting value (MERV) OF 8, as determined by ASHRAE 52.2-2007, with errata (or equivalent filtration media class of 5 or higher, as defined by CEN Standard EN 779-2002, Particular Air Filters for General Ventilation Determination of the Filtration Performance), are installed at each return air grille and return or transfer duct inlet opening such that there is no bypass around the filtration media. Immediately before occupancy, replace all filtration media with the final design filtration media, installed in accordance with the manufacturer's recommendations.

B. Indoor Air Quality Assessment: Option 2. Air Testing
   1. After construction ends and before occupancy, but under ventilation conditions typical for occupancy, conduct baseline IAQ testing using protocols consistent with the methods listed in Table 1 for all occupied spaces. Use current versions of ASTM standard methods, EPA compendium methods, or ISO methods, as indicated. Laboratories that conduct the tests for chemical analysis of formaldehyde and volatile organic compounds must be accredited under ISO/IEC 17025 for test methods they use.

1.5 IAQ MANAGEMENT PLAN SUBMITTALS

A. General: Coordinate IAQ submittals with other submittal requirements specified in the Technical Specification Sections, including material descriptions, product characteristics, and finishes; include IAQ data on furnished specialties and accessories.

B. Within 60 days prior to scheduled building enclosure, submit for approval:
   1. Detailed Construction Indoor Air Quality Management Plan.
      a. Meet or exceed control measures of Sheet Metal and Air Conditioning Contractor's National Association Indoor Air Quality Guidelines for occupied Buildings under Construction.
      b. Protect stored on site and installed absorptive materials from moisture damage.
         1) Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
         2) Describe procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed work, and replacing water-damaged work.
         3) Describe sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and concrete grinding. Describe plans for managing water from those operations. Show procedures for verifying that wet, construction has dried sufficiently to permit installation of finished materials.
      c. Use filtration media with a minimum efficiency reporting value (MERV) of 8 at each return grille, if permanently installed air handlers are used during construction.
      d. Prohibit smoking inside the building and within 25 feet of building entrances once the building is enclosed.
      e. Comply with detailed products and procedures for compliance with execution requirements outlined in Parts 2 and 3 of this Section.

2. Detailed Construction Indoor Air Quality Management Plan, Prior to Occupancy, as outlined in this Section.
    a. Indoor Air Quality Testing Schedule describing procedures and dates and as described elsewhere in this Section.
    b. Identify potential sources of odor and dust.
    c. Identify areas of Project potentially affected, especially occupied areas.
    d. Evaluate potential problems by severity and describe methods of control.
    e. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
    f. Describe cleaning and dust control procedures.
    g. Describe coordination with commissioning procedures.

C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to absorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
    1. Protect stored on-site or installed absorptive materials from dust, odor, and moisture.

D. Duct and Terminal Unit Inspection Report.

E. Air Contaminant Test Plan: Identify:
    1. Testing agency qualifications.
    2. Locations and scheduling of air sampling.
    3. Test procedures, in detail.
    4. Test instruments and apparatus.
    5. Sampling methods.

F. Air Contaminant Test Reports: Show:
    1. Location where each sample was taken, and time.
    2. Test values for each air sample.
    3. HVAC operating conditions.
    4. Certification of test equipment calibration.
    5. Other conditions or discrepancies that might have influenced results.

G. Ventilation Effectiveness Test Plan: Identify:
    1. Testing agency qualifications.
    2. Description of test spaces, including locations of air sampling.
    3. Test procedures, in detail; state whether tracer gas decay or step-up will be used.
    4. Test instruments and apparatus; identify tracer gas to be used.
    5. Sampling methods.

H. Ventilation Effectiveness Test Reports: Show:
    1. Include preliminary tests of instruments and apparatus and of test spaces.
    2. Calculation of ventilation effectiveness, E.
    3. Location where each sample was taken, and time.
    4. Test values for each air sample.
    5. HVAC operating conditions.
    6. Other information specified in ASHRAE 129.
    7. Other conditions or discrepancies that might have influenced results.

I. Product Data:
    1. Manufacturer product data indicating MERV rating of temporary and permanent filtration media with statement of where and when each filter was installed.
    2. Manufacturer product data indicating chemical content and Green Seal certification of cleaning products.'

J. Low-Emitting Materials: For each low-emitting product submitted, provide the following product data:
   1. Adhesives, sealants, paints and coatings: Proof of VOC content as measured in grams per Liter (g/L).
   2. Carpet: Proof of Green Label Plus certification.
   3. Resilient Flooring System: Proof of Floor Score certification or alternate compliance.
   4. Composite wood and agrifiber products: Manufacturer declaration that product contains no added urea-formaldehyde (NAUF).
   5. Laminating Glues: Manufacturer declaration that product contains no added urea-formaldehyde.
   6. Ceiling and Wall Systems (gypsum board, insulation, acoustical ceiling systems and wall coverings): Proof of compliance with California Department of Health Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda or alternate compliance.

1.6 CLOSEOUT SUBMITTALS

A. General: At completion of construction and prior to contract close-out, submit the following for information purposes in electronic format.
   1. Construction Indoor Air Quality Management Plan
      a. Required Documentation
         4) IAQ Management plan or detailed checklist, highlighting nonsmoking policy.
         5) Narrative description protection measures for absorbent materials.
         6) Annotated photographs of indoor air and environmental quality measures.
         7) Record of filtration media.
   2. Indoor Air Quality Assessment
      a. Required Documentation
         1) IAQ testing report.

1.8 PROJECT MEETINGS

A. Pre-Constructing Meeting: As part of the Pre-Construction meeting, discuss the proposed IAQ Management Plan and develop a mutual understanding relative to details of environmental protection.

1.9 QUALITY ASSURANCE

A. Coordination: Coordinate IQA management activities with additional environmental requirements specified in Division 01 through Division 49 Specification Sections.

B. Laboratory Test Requirements: Laboratory test shall be performed by ISO/IEC 17025 accredited laboratories.

C. Third Party Certification and Verification Requirements: Certification and verification of environmental product claims shall be performed by ISO/IEC 17065 accredited certification bodies.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Products used on the Project shall be as new, shall not have been exposed to water, and shall not have visible mold or mildew growth.

B. Moisture Protection: Protect interior materials from water intrusion or penetration.
   1. Porous or fibrous materials with visible mold or mildew growth shall not be installed and shall be removed from the site and disposed of appropriately.
   2. Notify Owner and A/E immediately if mold or mildew is detected. Once discovered, no onsite or offsite treatment of mold and mildew with cleaning agents or other chemicals, including ozone, is permitted.
   3. Keep porous and organic materials from coming into prolonged contact with any concrete surface.
   4. Remove standing water from decks, keep deck openings covered to prevent water intrusion into the project.

1.11 CLEANING AND PROTECTION, ENVIRONMENTAL ISSUES

A. Cleaning Agents, General: Use cleaning products and agents recommended by or acceptable to manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that may damage finished surfaces. Preferentially use cleaning agents with safer ingredients as defined by governmental or non-governmental programs.

B. Final Cleaning, Environmental Issues: Use nontoxic cleaning and maintenance products as described in this Section.
   1. Comply with IAQ Management Plant During Construction, Housekeeping, as specified in this Section.
   2. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces.
   3. Clean equipment and fixtures to sanitary condition.
   4. Remove and properly dispose of recyclable materials using a specified construction waste management program.

PART 2 - PRODUCTS

2.1 LOW-EMITTING MATERIALS

A. Adhesives applied within the building waterproofing envelope: Comply with VOC content limits below, as expressed in grams per Liter, less water and exempt compounds, of South Coast Air Quality Management District (SCAQMD) Rule 1168 “Adhesive and Sealant Applications,” amended January 7, 2005, or more stringent levels. Adhesives and Sealants integral to waterproofing system are exempt.

B. Aerosol Adhesives applied within building waterproofing envelope: Comply with the VOC Content limits, as expressed in percentage of VOC by weight, of Green Seal Standard GS-36 “Commercial Adhesives,” October 19, 2000.

C. Sealants applied within building waterproofing envelope: Comply with VOC content limits, as expressed in grams per Liter, less water and exempt compounds, of SCAQMD Rule 1168 “Adhesive and Sealant Applications,” amended January 7, 2005.

D. Sealant primers applied within building waterproofing envelope: Comply with VOC content limits, as expressed in grams per Liter, less water and exempt compounds, of SCAQMD Rule 1168 “Adhesive and Sealant Applications,” amended January 7, 2005.

E. Paints and coatings applied within building waterproofing envelope: Comply with the following VOC content limits as expressed in grams per Liter, less water and exempt compounds, of Green Seal Standard GS-11 “Paints,” First Edition, May 20, 1993; Green Seal Standard GC-03 “Anti-Corrosive Paints,” Second Edition, January 7, 1997; and SCAQMD Rule #1113 “Architectural Coatings,” January 1, 2004.

F. Carpets: Comply with testing and product requirements of the Carpet and Rug Institute Green Label Plus program.

G. Hard Surface Flooring and Wall Base System (vinyl, linoleum, laminate, rubber, wood flooring - except solid unfinished wood and mineral-based integrally finished flooring): Comply with testing and product requirements of the Resilient Floor Covering Institute's FloorScore Program.
   1. Option 1: Comply with the testing and product requirements of the California Department of Health Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda (California Section 01350 Specification). The following are options to demonstrate compliance.
      a. Listed in the Collaborative for High Performance Schools (CHPS) High Performance Product Database.
      b. Certified by GREENGUARD Gold (formerly Children and Schools).

H. Permanently installed composite wood and agrifiber products (particleboard, medium density, plywood, wheatboard, strawboard, panel substrates and door cores): No added urea-formaldehyde resins.

I. Laminating adhesives used in composite wood and agrifiber product assemblies, shop-applied and applied on-site: No added urea-formaldehyde resins.

J. Ceiling and Wall Systems (gypsum board, insulation, acoustical ceiling systems and wall coverings): Comply with the testing and product requirements of the California Department of Health Services Standard Practice for The Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda (California Section 01350 Specification). The following are options to demonstrate compliance.
   1. Certified by GREENGUARD Gold (formerly Children and Schools).
   2. Listed in the Collaborative for High Performance Schools (CHPS) High Performance Product Database.
   3. Certified by SCS Indoor Advantage Gold.

2.2 AIR FILTRATION MEDIA

A. Temporary Filters: Filtration media rated for minimum efficiency reporting value (MERV) when tested in accordance with ASHRAE 52.2.
   1. MERV of 8, minimum.

B. Permanent Filters for outdoor air intake: Filtration media rated for minimum efficiency reporting value (MERV) when tested in accordance with ASHRAE 52.2.
   1. MERV of 13, minimum.

2.3 CLEANING PRODUCTS AND EQUIPMENT

A. Use Green Seal qualified spot removers and cleaning agents for each given application.

B. Use HEPA-filter equipped vacuum cleaners for the final cleaning.

PART 3 EXECUTION

3.1 GENERAL

A. Incorporate procedures and processes during Construction and prior to occupancy as described herein.
   1. Prevent the absorption of moisture and humidity by adsorptive materials by:
      a. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
      b. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.

c. Provide sufficient ventilation for drying within reasonable time frame.
d. Prohibit smoking on construction site.

2. Begin construction ventilation when building is substantially enclosed.
3. If extremely dusty or dirty work must be conducted inside the building, shut down HVAC systems for the duration; remove dust and dirt completely before restarting systems.
4. When working in a portion of an occupied building, prevent movement of air from construction area to occupied area.
5. HVAC equipment and ductwork may NOT be used for ventilation during construction. Where outlined in other sections that HVAC equipment can NOT be used the following procedure applies. Coordinate use of all HVAC equipment with Owner.
   a. Provide temporary ventilation equivalent to 1.5 air changes per hour, minimum.
   b. Exhaust directly to outside.
6. Do not perform any dusty or dirty work after starting use of return air ducts without intake filters.
7. Use other relevant recommendations of SMACNA IAQ Guideline for Occupied Buildings Under Construction for avoiding unnecessary contamination due to construction procedures.

3.2 HVAC PROTECTION

A If permanent HVAC is used during construction: Use filtration media at each return air grill. All HVAC systems, equipment and pathways to be dust and particulate free at time of substantial completion of that phase of construction, in accordance with SMACNA “IAQ Guidelines for Occupied Buildings Under Construction.”

1. Begin construction ventilation when building is substantially enclosed.
2. Prevent movement of air from construction area to occupied area when working in a portion of an occupied building.

B. Keep HVAC system clean, free of dust, debris, moisture, gaseous and microbial contamination during storage, handling, installation and punch-out. Inspect all air inlets, air outlets, grilles, diffusers, plenums, and ducts upon completion of work.

1. Cover and protect (taped plastic or similar method) all exposed air inlet and outlet openings, grilles, ducts, plenums, to prevent water, moisture, dust and other contaminate intrusion.
2. Apply protection immediately after installation of equipment and ducting.
3. Protect at end of each Work day duct runs that require more than a single day to install.
4. Check and repair leaks in return ducts and air handlers.
5. Do not use mechanical rooms for construction storage.
6. Inspect filtration monthly and replace as needed with new MERV 8 filtration media throughout the HVAC system.
7. Install new filtration media throughout the HVAC system after final phase of construction.
8. Cleaning of ductwork is not part of this contract; however GC to bear cost of cleaning required by Owner due to failure of GC to protect ducts and equipment from construction pollutants as specified.

C. Install all ceiling tiles prior to HVAC use if an un-ducted plenum must be used over a construction zone.

3.3 SOURCE CONTROL

A. Comply with product specifications.

B. Prohibit smoking and limit use of fossil-fueled temporary heating units to propane-powered only inside the building and near building entrances, windows and intakes and within 25 feet of building entrances.

C. Provide direct exhaust to the exterior during use of fossil-fueled temporary heating units, installation of strong emitting materials, including touch-up activities. Keep exhaust away from intakes and occupied spaces.

D. Protect “absorptive” or dry sink materials from exposure to dust, debris and moisture contamination during product delivery, storage and handling from construction, demolition and punch-out activities.

E. Provide adequate ventilation of packaged dry products prior to installation.
   1. Remove from package and place in a secure, dry, well-ventilated space, free from contaminant sources and residues.
   2. Provide temperature range of 60 degrees Fahrenheit minimum to 90 degrees maximum continuously during ventilations period.
      a. Do not ventilate within limits of Work unless otherwise approved by Architect.

F. “Bake-out” or “super-heating” of spaces to accelerate the release of gaseous emissions is not permitted.

3.4 PATHWAY INTERUPTION

A. Provide negative pressurization of spaces under construction and/or demolition and positive pressurization of occupied or finished spaces while construction work proceeds in adjacent areas.

B. Relocate pollutant sources when project equipment or staging areas coincide with critical air flow pathways and place plastic barriers to contain construction areas.

C. Temporarily seal building, including air intakes and exhaust vents, and any other building openings, when dust-generating or strong-emitting construction products or procedures are used on the exterior of the building.

D. Once spaces within building become occupied, work areas must remain under negative pressure. Exhaust air at a rate at least 10 percent greater than the rate of supply.
   1. Do not exhaust air where it can be drawn back into occupied spaces.
   2. Place continuous plastic barriers creating a seal between construction areas and occupied spaces.

3.5 HOUSEKEEPING

A. Broom clean and vacuum floors to keep dust from accumulating during construction and demolition. Remove debris from building on a daily basis and suppress dust during construction and demolition activities with wetting agents or sweeping compounds.

B. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
   1. Inspect duct intakes, return air grilles, and terminal units for dust.
   2. Clean plenum spaces, including top sides of lay-in ceilings, outside of ducts, tops of pipes and conduit, and return plenums of air handling units.
   3. Clean tops of doors and frames.
   4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
   5. Remove intake filters last, after cleaning is complete.

C. Ensure food and food packaging is not left on the jobsite.

D. Use low-toxic pest control chemicals such as boron, if needed, unless otherwise directed.

E. Use HEPA-filter vacuum throughout for final detailed cleaning.

F. Remove spills or excess application of solvent-containing products as soon as possible. Use low-emitting cleaning agents described under CLEANING PRODUCTS AND EQUIPMENT.

G. Keep work areas as dry as possible. Replace any absorptive (dry sink) material that is exposed to moisture.

3.6 SCHEDULING

A. Coordinate construction activities to minimize or eliminate disruption of operations in occupied portions of building.

B. Schedule for storage, installation, and protection of all components of air distribution systems.

C. Schedule for storage, installation, and protection of absorptive materials (woven, fibrous or porous, such as carpet, ceiling tiles, insulation, and fabrics) from exposure to emissions during and after installation from materials and finishes with potential for short-term release of off-gassing volatile organic compounds.
   1. Highlight critical methods used to protect absorptive materials from airborne pollutants such as dust, debris, moisture, gaseous and microbial contamination.
   2. Sequence installation of absorptive materials after odor-emitting activities have occurred and have been mitigated by ventilation.

D. Do not store absorptive materials on-site if protection measures as described above cannot be ensured.

E. Avoid building occupancy while construction related pollutants are present.

F. Ensure proper and complete curing of concrete before covering.

3.7 INDOOR AIR QUALITY MANAGEMENT, PRIOR TO OCCUPANCY

A. Provide Indoor Air Quality Testing after construction ends, prior to occupancy, with all interior finishes installed, and with the building completely cleaned.

B. Do not start air contaminant testing until:
   1. All construction is complete, including interior finishes.
   2. HVAC systems have been tested, adjusted, and balanced for proper operation.
   3. Cleaning of inside of HVAC ductwork, specified elsewhere, has been completed.
      a. Inspection of inside of return air ducts and terminal units confirms to satisfaction of A/E that cleaning is not necessary.
   4. New HVAC filtration media have been installed.

C. Testing must be done in accordance with one standard.
   1. Provide the services of a qualified Indoor Air Quality Testing Services Firm.
   2. Support the Indoor Air Quality Testing Services Firm by coordinating scheduling of required testing, and providing services during IAQ remediation if necessary.
   3. Step 1. Determine Air-Testing Locations

a. Select testing locations with the least ventilation but the greatest concentration of VOCs and other contaminants. Testing must be completed by an appropriately accredited professional. Use current versions of ASTM or ISO methods. The number of testing locations depends on the size of the building and number of ventilation systems but must include all occupied spaces. If sampling is used, all space types must be represented (e.g., office and classroom). Use the following methodology to determine how many air testing locations are required.
   1) Test at least one location per ventilation system for each occupied space type. There must be a minimum of one test per floor. The locations selected for testing must represent the worst-case zones where the highest concentrations of contaminants of concern are likely to occur.
   2) For school projects, test areas no larger than 5,000 square feet. For warehouses or larger open spaces in other building types, a limit of 50,000 square feet may be used. If there is evidence that the air in the space is well mixed and sources of contaminants of concern are uniform, project teams may test a single location in that space.
   3) Determine whether the project includes spaces (e.g., offices, school classrooms, or multifamily residential units) that are identical in their construction, finishes, configuration, square footage, and HVAC systems. Project teams may sample identical spaces by testing one in seven. If the sampled space fails the last, all seven must be tested.

2. Step 2. Perform Test
   a. Ensure that the following procedures are followed at all test locations. If a test fails, take corrective action (e.g., clean and flush out the space) and retest. The duration of any flush-out between tests is at the discretion of the project team.
      1) The measurement equipment must be positioned in the breathing zone, between 3 and 6 feet above the floor.
      2) The test must occur during normal occupied hours, with the HVAC system starting at the normal start time and delivering outdoor air at the minimum rate.
      3) The gravimetric method must be used for testing.
3. Step 3. Prepare Indoor Air Quality Testing Report
   a. Develop an IAQ testing report that includes the following:
      1) Narrative describing procedures and how locations were determined.
      2) Dates and results of each test.

3.9 VENTILATION EFFECTIVENESS TESTING

A. Perform ventilation effectiveness testing during commissioning period.

B. Do not begin ventilation effectiveness testing until:
   1. HVAC testing, adjusting, and balancing has been satisfactorily completed.
   2. Air contaminant testing has been completed satisfactorily.
   3. New HVAC filtration media have been installed.

C. Test each air handler zone in accordance with ASHRAE 129.

D. If calculated air change effectiveness for a particular zone is less than 0.8 due to inadequate balancing of the system, adjust, and retest at no cost to Owner.

END OF SECTION 01 81 19

SUBSTITUTION REQUEST
(After the Bidding Phase)

FANNING HOWEY

Project: Lake Campus Workforce Development Project

To: _____

Re: _____

From: _____

Date: _____

A/E Project Number: WSU-231035/224102.00

Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

☐ Point-by-point comparative data attached

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SUBSTITUTION REQUEST
(Continued)

FANNING HOWEY

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01 33 00.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 33 00.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____
(Project Manager)

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ _____

_____

_____

_____

_____

_____

_____

SECTION 01 32 00.01 – MILESTONE SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Milestone dates to be used in contractor's development of the "Preliminary Construction Schedule" and "Contractor's Construction Schedule".

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 MILESTONE SCHEDULE

A. Work begins with the Owners issuance of the Notice to Proceed. Work shall be Substantially Complete by November 5, 2027.

END OF SECTION 01 32 00.01

SECTION 01 33 00.00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Submittal schedule requirements.
   2. Administrative and procedural requirements for submittals.

B. Related Sections:
   1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.
   2. Division 01 Section "Project Management and Coordination" for submitting and distributing meeting and meeting minutes and for submitting Coordination Drawings.
   3. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule [and the Submittals Schedule].
   4. Division 01 Section "Quality Requirements" for:
      a. Submitting test and inspection reports.
      b. Mock-up requirements.
   5. Division 01 Section "Closeout Procedures" for submitting warranties.
   6. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
   7. Division 01 Section "Project Record Documents" for submitting record Drawings, and record Product Data, shop drawings, samples, training information, warranties, etc.
   8. Division 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require A/E's responsive action. Action submittals are those submittals indicated in individual specification sections as “Action Submittals”.

B. Informational Submittals: Written and graphic information and physical samples that do not require A/E's responsive action. Submittals may be rejected for not complying with requirements. Information submittals are those submittals indicated in individual specification sections as “Informational Submittals.”

C. Closeout Submittals: Written and graphic information and physical extra stock items required at or near completion of a project. Requirements for those submittals are included in the General Conditions of the contract and Division 01 Section “Closeout Procedures”.

D. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

E. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the A/E and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   2. Initial Submittal: Submit concurrently with start-up construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work, those required early because of long lead time for manufacture or fabrication, and those indicated as “Expedited” below.
   3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
      a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
   4. Format: Arrange the following minimum information in a tabular format:
      a. Scheduled date for first submittal.
      b. Specification Section number and title.
      c. Submittal category: Action, informational, or quality assurance/control submittal.
      d. Name of subcontractor.
      e. Description of the Work covered.
      f. Scheduled date for A/E's final release or approval.

B. Submit submittal schedule to A/E at earliest possible date but no later than seven days before the date scheduled for submittal of initial Application for Payment.
   1. Failure to provide Submittal Schedule may delay initial payment and submittal approvals.
   2. Failure to provide a Submittal Schedule also precludes the Contractor delay claims related to late return of submittals.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. A/E's Digital Data Files: Digital data drawing files of the Contract Drawings will be provided by A/E for Contractor's use in preparing submittals.
   1. A/E may furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project Record Drawings.
      a. A/E makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings and Project Record Drawings.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
   3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
   4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      a. Where submission of samples, shop drawings, or other items are required from suppliers or subcontractors, it shall be the responsibility of the Contractor for whom the subcontractor is executing the Work to see that the submittal items required are complete and properly submitted, and corrected and resubmitted on the time and in the order required so as not to delay the progress of the Work. Submittals shall include sufficient detail to determine that the contractor clearly understands the requirements of the Contract Documents.

b. Contractors on this Project shall provide submittals in accordance with the requirements of this Section. Where a submittal is required by a Contractor but assistance needed from others, Contractors shall participate and cooperate to expedite each submittal. .
c. A/E reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on A/E's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. A/E will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: Allow 14 days for review of each resubmittal.
3. Concurrent Review: Where concurrent review of submittals by A/E's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal. Sections to be scheduled for concurrent review include the following:
a. Division 03 Section “Concrete Mix Design Submittal”
b. Division 03 Section "Cast-in-Place Concrete”
c. Division 05 Section “Structural Steel Framing”
d. Division 05 Section “Steel Joists Framing”
e. Division 05 Section "Steel Decking”
f. Division 05 Section "Cold-Formed Metal Framing”
4. Expedited Submittals: Long lead items need to take priority because a delay in their review may have undesirable consequences. Some submittals must be submitted before permits can be obtained. Both long lead items and items necessary for permits are to be issued within 60 days of the Notice to Proceed, unless otherwise approved by A/E in writing. These items include, but are not limited to the following:
a. Division 05 Section “Structural Steel Framing”
b. Division 05 Section "Steel Joist Framing"
c. Division 05 Section "Cold-Formed Metal Framing”
d. Division 07 Section “Penetration Firestopping”
5. Submittals Not Requested or Not Required: A/E will send a transmittal indicating submittals were “not required for review”. All copies of the submittals may be disposed of by the A/E.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single bookmarked file with links enabling navigation to each item.
2. Each submittal shall be transmitted separately and shall cover only one specification section.
3. Name file with submittal number or other unique identifier, including revision identifier.
a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
4. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by A/E.
5. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software or electronic form acceptable to A/E containing the following information.
a. Project name.
b. Date.
c. Name and address of A/E.
d. General Contractor.
e. Name of subcontractor.
f. Name of firm or entity that prepared submittal.

g. Name of subcontractor, manufacturer, and supplier.
h. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
i. Category and type of submittal.
j. Submittal purpose and description.
k. Specification Section, number and title, with paragraph number and generic name for each of multiple items.
l. Drawing number and detail references, as appropriate.
m. Location(s) where product is to be installed, as appropriate.
n. Related physical samples submitted directly.
o. Indication of full or partial submittal
p. Transmittal number, numbered consecutively.
q. Submittal and transmittal distribution record.
r. Other necessary identification.
s. Remarks.

6. Include the following information as keywords in the electronic file metadata:
a. Project name.
b. Number and title of appropriate Specification Section.
c. Manufacturer name.
d. Product name.

E. Options: Identify options requiring selection by the A/E.

F. Deviations and Additional Information: On an attached separate document, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by A/E on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from A/E's action stamp.

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
1. Final Shop Drawings: Furnish one full-size copy (as marked) to be kept at the Project site or provide easy access to clearly labeled electronic file.

I. Use for Construction: Use only final submittals that are marked "Reviewed" or "Furnish as Corrected" from A/E's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES, GENERAL

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections. Submit electronic submittals in one of the following formats as agreed upon in Preconstruction Meeting.
1. Submit electronic submittals via email as PDF electronic files.
a. A/E will return annotated file and copy to WSU Project Manager. Annotate and retain one copy of file as an electronic Project record document file.
2. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."

3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
    b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
4. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."

B. Electronic submittals will only be accepted in an unchangeable electronic format such as pdf. File formats such as MS Word (.doc or .docx), MS Excel (.xls or xlsx), AutoDesk, AutoCAD (.dwg or .dwf), are considered unacceptable as the original file submitted could be accidentally altered from the originators intended document. These file types will be rejected by A/E.

C. Fanning Howey Email Submittals: This shall be the primary means of electronic submittals less than 15MB.
1. Email submittals to be sent to 01submittal@fanninghowey.com.
2. Emails sent directly to FH staff will be rejected.

D. Fanning Howey File Transfer Site (Newforma Info Exchange): This shall be the primary means of electronic submittals greater than 15MB for the Project. The Info Exchange Project website does not have file size restrictions.
1. External team members will be added to the Project Team and are granted access to the Fanning Howey Newforma Info Exchange project website.
2. Invitations will be emailed to external team members for setting-up login information.
3. Once access is gained, external team members will be able to upload submittals and check the status of the pending submittals.

2.2 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual specification sections.

B. Product Data: Collect information into a single submittal for each element of construction or system. Product data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Contractor must annotate information. Highlighting choices or striking out product not required is acceptable. Product data unmarked by Contractor may be returned unreviewed by A/E. Include the following information, as applicable:
    a. Manufacturer's catalog cuts
    b. Manufacturer's product specifications
    c. Manufacturer's installation instructions
    d. Standard color charts
    e. Statement of compliance with specified referenced standards and trade association standards.
    f. Testing by recognized testing agency standards.
    g. Application of testing agency labels and seals.
    h. Notation of coordination requirements.
    i. Availability and delivery time information.
3. For equipment, include the following in addition to the above, as applicable.
    a. Wiring diagrams showing factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.

d. Clearances required to other construction, if not indicated on accompanying shop drawings.

4. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed. Submit before or concurrent with samples and Shop Drawings.
5. If a product changes or a name change has occurred an accompanying letter of explanation with the submittal is in order.
6. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
   a. Do not proceed with installation until a copy of Product Data is in the Installer's possession.
   b. Do not permit use of unsubmitted copies of Product Data in connection with construction.
7. In compliance with the OSHA Hazard Communication Standard (1910.1200, 08-24-1987) Contractors shall post at the site MSDS (Material Safety Data Sheets) for ALL products classified as hazardous that their firm has knowledge that they will be furnishing, using, or storing on the jobsite during the duration of this Project in accordance with OSHA standards. At the completion of the project, the Contractor shall turn their "MSDS" information directly over to the Owner with a receipt for the Owner to sign. A copy of the signed receipt only shall be submitted to the A/E.
   a. Material Safety Data Sheets (MSDS) should not be submitted to the A/E for review. Material Safety Data Sheets submitted to A/E will be removed or cross out with no action taken.
8. Submit product data in the following format:
   a. PDF electronic file.

C. Shop Drawings: Prepare project specific information, drawn accurately to scale. Do not base shop drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on A/E's digital data drawing files is otherwise permitted.
   1. The Contractor shall perform no portion of the Work requiring submittal and review of shop drawings, product data, samples or similar submittals until the A/E has approved the respective submittal. Such Work shall be in accordance with approved submittals.
   2. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the bases of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.
   3. Shop drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data that are prepared by the Contractor or subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work. Shop drawings are to be specially prepared for a specific Product to show how a given item is to be fabricated and installed; this is what distinguishes shop drawings from product data. Shop drawing show how the Contractor intends to fulfill contractual obligations and reflect the Contractor understands of the information given in the Contract Documents. Contract Documents do not show every condition that may exist, and they do not fully indicate how every part and piece must be fabricated or incorporated into the Construction. Preparing accurate Shop Drawings provides the opportunity to fully detail all conditions and show how requirements will be satisfied. Do not base shop drawings on reproduction of the Contract Documents.
      a. Advertising brochures will not be accepted as shop drawings.
      b. Erection and setting drawings as referred to in these Specifications will be considered as shop drawings and shall be submitted along with detailed shop drawings.
      c. Where schedules are required to indicate locations, they shall be submitted as part of the shop drawings package for that item.
      d. Shop drawings and schedules shall repeat the identification shown on the Contract Drawings.

e. The Contractor shall check all shop drawings, samples and other submittals and submit them to the A/E utilizing a Transmittal Form, giving his approval and/or comments and suggestions. Failure to use a Transmittal Form will result in submittals being returned “without action”.

f. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   1) Identification of products and materials included by sheet and detail number
   2) Compliance with specified standards
   3) Notation of coordination requirements
   4) Notation of dimensions established by field measurements
   5) Fabrication and installation drawings
   6) Roughing-in and setting diagrams
   7) Wiring diagrams showing field installed wiring, including power, signal, and control wiring
   8) Shop work manufacturing instructions
   9) Templates and patterns
   10) Schedules
   11) Seal and signature of professional engineer, if specified.
   12) Relationship and attachment to adjoining construction clearly indicated.

4. Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, submittal name, and similar information to distinguish it from other submittals. Show Contractor’s executed review and approval marking and provide space for A/E’s “action” marking. Package each submittal appropriately for transmittal and handling.
5. By approving and submitting shop drawings, the Contractor thereby represents that they have determined and verified field measurements, field construction criteria, materials, catalog numbers, and similar data, and that they have checked and coordinated each shop drawing with the requirements of the Work and of the Contract Documents prior to submitting to the A/E.
6. The Contractor shall make corrections required by the A/E and shall resubmit shop drawings until appropriately marked. The Contractor shall direct specific attention in writing or on resubmitted shop drawings to revisions other than the corrections requested by the A/E on previous submissions.
7. The A/E will review shop drawings only for conformance with the design concept of the Project and with the information given in the Contract Documents. The A/E’s review of a separate item shall not indicate review of an assembly in which the item functions.
8. The A/E’s review of shop drawings shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has informed the A/E in writing of such deviation at the time of submission and the A/E has given written approval to the specific deviation, nor shall the A/E’s action relieve the Contractor from responsibility for errors or omissions in the shop drawings.
   a. The A/E shall review and approved or take other appropriate act on the Contractor submittals, such as shop drawings, product data, samples and other data, which the Contractor is required to submit, but only for the limited purpose of checking for conformance with the design concept and the information shown in the Construction Documents. This review shall not include review of the accuracy or completeness of details, such as quantities, dimensions, weight or gauges fabrication processes, construction means or methods, coordination of the work with other trades or construction safety precautions, all of which are the sole responsibility of the Contractor. Review of a specific item shall not indicate that the A/E has reviewed the entire assembly of which the item is a component. The A/E shall not be responsible for any deviations from the Contract Documents not brought to the attention of the Consultant in writing by the Contractor. The A/E shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
9. Notations and remarks added to shop drawings by the A/E are to ensure compliance to Drawings and Specifications and do not imply a requested or approved change to contract cost.

10. Should deviations, discrepancies, or conflicts between shop and contract drawings and Specifications be discovered, either prior to or after review, Contract Documents shall control and be followed.
11. Submit shop drawings in the following format:
    a. PDF electronic file.
12. Shop drawings not requested by the A/E shall be returned without action.
13. BIM File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.
    a. Prepare Shop Drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.

D. Samples for Initial Selection: Prepare physical units of materials or products, including the following:
1. The Contractor shall submit to the A/E samples to illustrate materials or workmanship, colors, and textures, and establish standards by which the Work will be judged.
    a. Transmit samples that contain multiple, related components such as accessories together in one submittal package.
        1) When possible, Contractor is encouraged to give samples to Construction Administrators.
2. Identification: Attach label on unexposed side of samples that includes the following:
    a. Project name and submittal number.
    b. Generic description of sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable specification section.
    f. Specification paragraph number and generic name of each item.
3. Email Transmittal: Provide corresponding electronic submittal of sample transmittal, digital image file illustrating sample characteristics, and identification information for record.
4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based project software website. Enter required data in web-based software site to fully identify submittal.
5. Samples for Initial Selection: For color selections when colors are not preselected, submit manufacturer's color published charts consisting of units or sections of units showing the full range of colors, textures, and patterns available. Reproductions, facsimiles, or copies will be rejected.
    a. Number of Samples for Initial Selection: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. A/E will return transmittal with options indicated.

E. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively, used materials; swatches showing color, texture and pattern; color range sets.
1. Number of Samples for Verification: Submit 2 sets of samples, unless otherwise noted.
    a. Submit a single sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
    b. If variation in color, pattern, texture, or other characteristics is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
2. Email Transmittal: Provide corresponding electronic submittal of sample transmittal, digital image file illustrating sample characteristics, and identification information for record.
    a. Contractor shall receive written notification.

3. Disposition: Maintain one set of approved samples at project site, available for quality control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
4. Identification: Permanently attach label on unexposed side of Samples that include the following:
    a. Product name and submittal number.
    b. Generic description of the sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.
5. By approving and submitting samples, the Contractor thereby represents that he has determined and verified materials, catalog numbers, and similar data, and that he has checked and coordinated each sample with the requirements of the Work and of the Contract Documents prior to submitting to the A/E.
6. The Contractor shall resubmit the required number of correct or new samples until approved. The Contractor shall direct specific attention in writing or on resubmitted samples to revisions other than the changes requested by the A/E on previous submissions.
7. The A/E will review samples but only for conformance with the design concept of the Project and with the information given in the Contract Documents. The A/E's review of a separate item shall not indicate approval of an assembly in which the item functions.
8. The A/E's action shall not relieve the Contractor of responsibility for deviations from the requirements of the Contract Documents unless the Contractor has informed the A/E in writing of the deviation at the time of submission and the A/E has given written approval to the specific deviation, nor shall the A/E's action relieve the Contractor from responsibility for errors or omissions in the samples.
9. Materials shall not be ordered until final review is received in writing from the A/E. Materials shall be furnished, equal in every respect to reviewed samples. Where color or shade cannot be guaranteed, the manufacturer shall indicate the maximum deviation. Work shall be in accordance with the final reviewed samples.

2.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. General: Prepare and submit informational submittals required by other Specification Sections.

B. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of A/E's and Owners, and other information specified.

C. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumption and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

D. Certificates:
1. Certificates and Certification Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized for this specific project.

3. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
4. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.
5. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

E. Test and Research Reports:
1. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.
3. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
4. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.
5. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
    a. Test reports shall be no older than 15 months, unless otherwise noted or approved by A/E.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

F. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates
2. Required substrate tolerances
3. Sequence of installation or erection
4. Required installation tolerances
5. Required adjustments
6. Recommendations for cleaning and protection

G. Manufacturer's Field Reports: Prepare written information documenting factory authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory authorized service representative making report.

2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

H. Material Safety Data Sheets (MSDSs) or Safety Data Sheet(s): Submit information directly to Owner; do not submit to A/E. MSDS are to be collected and field as the jobsite by the Contractor as required by OSHA and other authorities. They communicate, to the Contractor's employees and other persons authorized to be on the Project site, important information about hazardous materials, such as their chemical and common names; ingredients that have been determined to be health hazards or carcinogens; physical and chemical characteristics; ingredients that have been determined to be physical hazards (potential for fire, explosion, reactivity, and so forth); health hazards, including signs and symptoms of exposures; and the OSHA – permissible exposure limit. Also included are precautions for their safe handling and use along with emergency and first-aid procedures to follow in case of exposure.
1. This information relates directly to construction safety, which is the sole responsibility of the Contractor.
2. MSDS or SDS shall not be submitted to the A/E for review.
3. MSDS or SDS submitted to A/E will be either removed or crossed out of submittal with no action taken.

I. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination".

J. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

K. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."

L. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

M. Subcontractors and Major Material Suppliers List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Submit subcontract list in the following format:
   a. PDF electronic file.

2.4 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
1. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 01 Section "Closeout Procedures".

B. At conclusion of Project 100% complete project manuals containing all shop drawings, samples, training information, warranties, etc., as required by front end sections will be required.

2.5 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to A/E.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM File Incorporation: Incorporate delegated-design drawing and data files into Building Information Model established for Project.
   1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as the original Drawings.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational/Quality Assurance/Control Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to A/E.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."

C. Contractor’s Approval: Indicate Contractor’s approval for each submittal with a uniform, approval stamp or indication in web-based Project Management Software. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
   1. A/E will not review submittals received from Contractor that do not have Contractor’s review and approval.

3.2 A/E'S ACTION

A. General: A/E will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: A/E will review each submittal, make marks to indicate corrections or modifications required, and return it. A/E will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
   1. Shop drawings will be marked as follows: Contractor shall take the following action for each respective marking:
      a. "REVIEWED" – Contractor shall make and distribute copies.
      b. “FURNISH AS CORRECTED” – Final Release; Contractor may proceed with fabrication, taking into account the necessary corrections on submittal or attached and with Contract Documents.

c. "REVISE AND RESUBMIT" - Contractor may proceed with fabrication, taking into account the necessary corrections. Corrected shop drawings shall be resubmitted before fabrication of this work is complete to obtain a different action marking. Do not allow drawings marked "Resubmit" to be used in connection with installation of the Work.

d. "REJECTED" - Contractor will be required to resubmit shop drawings in their entirety. No fabrication or installation shall be started until shop drawings so marked have been completely revised, resubmitted, and marked by A/E according to preceding Paragraphs a., b., or c.

e. “SUBMIT SPECIFIED ITEM” – Contractor shall not submit substitutions in Shop Drawings. Submittal is rejected. Submit specified item.

f. “NOT REQUIRED FOR REVIEW (INFORMATIONAL) – Contractor shall submit Information Submittals for A/E records only.

C. Informational/Quality Assurance/Control Submittals: A/E will review each submittal and will not return it or will return it if it does not comply with requirements.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from A/E.

E. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 33 00

SECTION 01 33 13.01 – STEEL FABRICATOR CERTIFICATION

Steel Fabricator Certification

The steel fabricator identified below certifies that for this project all load-bearing structural steel (as defined by the State of Ohio Department of Administrative Services, Directive Number _____, dated _____, has been fabricated or produced, to the best of its knowledge, only from steel made in the United States in accordance with Sections 153.011 and 153.99, of the Ohio Revised Code (ORC). Further, the steel fabricator hereby certifies that it has read and understands that a monetary penalty for violations may be imposed under the authority of the referenced sections of the ORC.

[Printed or Typed Name of Fabrication Company]
by
[Printed or Typed Name of Company Official]

_____ _____
Signature of Company Official Date

SECTION 01 33 13.02 – CONTRACTOR CERTIFICATION

Contractor Certification

The Contractor identified below certifies that it has required as a condition of purchase, that for this project all load-bearing structural steel (as defined by the State of Ohio Department of Administrative Services, Directive Number _____, dated _____, shall be fabricated and produced using, to the best of its knowledge, only steel made in the United States in accordance with Sections 153.011 and 153.99 of the Ohio Revised Code (ORC). Further, the Contractor certifies that it has read and understands that a monetary penalty for violations may be imposed under the authority of the referenced sections of the ORC.

[Printed or Typed Contractor Company Name]
By
[Printed or Typed Name and Title of Contractor Company Official]

_____ _____
Signature of Company Official Date

Owner Logo

OWNER NAME
Project Name

In partnership with:

Ohio Facilities Construction Commission

Architect:

Architect Logo

Contractor:

Contractor Logo

Contractor:

Contractor Logo

Site Photo/Rendering
(6.52 in x 4.98 in)

COMPLETION DATE (SEASON/YEAR)

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
   1. It is the intent of the Specifications and Drawings to accomplish a complete and first-rate installation executed by competent and experienced workmen.
   2. Equipment, specialties, and similar items shall be checked for compliance and approved prior to installation. GC is cautioned that work or equipment installed without approval is subject to condemnation, removal, and subsequent replacement with an approved item without extra remuneration.

B. Related Sections include the following:
   1. Division 01 Section “Indoor Air Quality Management” for additional storage requirements.
   2. Division 01 Section "References" for applicable industry standards for products specified.
   3. Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
   4. Divisions 02 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that are equivalent to or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by GC.
   1. Substitutions after Bid Opening
      a. The A/E should consider Requests for Substitutions after the bid opening only when the GC can conclusively demonstrate to the A/E the following conditions:
         1) The specified Basis-of-Design Components, Acceptable Components, or Substitutions approved prior to the bid opening, through no fault of the GC or Subcontractors and Material Suppliers, are not available; or
         2) The specified Basis-of-Design Components, Acceptable Components, or previously-approved Substitutions will not perform as designed or intended.

1.3 QUALITY ASSURANCE

A. Compatibility of Options: If GC is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
   1. Refer to Division 01 Section “Indoor Air Quality Management” for additional storage requirements.
   2. Where GC has an option preference should be given to products with minimal packaging and easily recyclable packaging as defined in ASTM D5834.
   3. Maximize use of source reduction and recycling procedures outlined in ASTM D5834.

B. Delivery and Handling:
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:
   1. Store products to allow for inspection and measurement of quantity or counting of units.
   2. Store materials in a manner that will not endanger Project structure.
   3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   4. Store cementitious products and materials on elevated platforms.
   5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
   6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   7. Protect stored products from damage and liquids from freezing.

D. GC shall be responsible for materials he orders for delivery to the jobsite. Responsibility includes, but is not limited to, receiving, unloading, storing, protecting, and setting in place; ready for final connections.
   1. The Owner will not be responsible for deliveries related to the construction or operation of the Contractor. The Owner cannot sign delivery forms for the GC.

E. GC shall insure that products are delivered to the Project in accordance with the Construction Progress Schedule of the Project. In determining date of delivery, sufficient time shall be allowed for shop drawings and sample approvals, including the possibility of having to resubmit improperly prepared submittals or products other than those specified and the necessary fabrication or procurement time along with the delivery method and distance involved.

1.5 WARRANTIES

A. Specific warranties or bonds called for in the Contract Documents, in addition to that falling under the general warranty as set forth in General Conditions, shall be furnished in accordance with the requirements of the Specifications.
   1. Owner’s Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.
      a. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

B. GC shall and does hereby agree to warrant for a period of one year, or for longer periods, where so provided in the Specifications, as evidenced by the date of Contract Completion issued by the A/E, products installed under the Contract to be of good quality in every respect and to remain so for periods described herein.

C. Should defects develop in the previously mentioned Work within the specified periods, due to faults in products or their workmanship, the GC hereby agrees to make repairs and do necessary Work to correct defective Work to the A/E's satisfaction, in accordance with the General and Supplementary Conditions. Such repairs and corrective Work, including costs of making good other Work damaged by or otherwise affected by making repairs or corrective Work, shall be done without cost to the Owner and at the entire cost and expense of the GC within 30 days after written notice to the GC by the Owner.
   1. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.
   2. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

D. Nothing herein intends or implies that the warranty shall apply to Work that has been abused or neglected or improperly maintained by the Owner or his successor in interest.

E. Where service on products is required under this Article, it shall be promptly provided when notified by the Owner and no additional charge shall be made, unless it can be established that the defect or malfunctioning was caused by abuse or accidental damage not to be expected under conditions of ordinary wear and tear.

F. In the event movement in the adjoining structure or components causes malfunctioning, the party responsible for the original installation of the adjoining structure or components shall provide such repair, replacement, or correction necessary to provide for proper functioning to bring the equipment back into the same operating condition as approved at the completion of the building.

G. The manufacturer and supplier expressly warrants that each item of equipment furnished by him and installed in this Project is suitable for the application shown and specified in the Contract Documents and includes features, accessories, and performing characteristics listed in the manufacturer's catalog in force on the date bids are requested for the Work. This warranty is intended as an assurance by the manufacturer that his equipment is not being misapplied and is fit and sufficient for the service intended. This warranty is in addition to and not in limitation of other warranties or remedies required by law or by the Contract Documents. It shall be the responsibility of the GC for the particular equipment to obtain this warranty in writing.

H. In case the GC fails to do Work so ordered, the Owner may have Work done and charge the cost thereof against monies retained as provided for in the Agreement and, if said retained monies shall be insufficient to pay such cost or if no money is available, the GC and his Sureties shall agree to pay to the Owner the cost of such Work.

I. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve GC of obligations under requirements of the Contract Documents.
   1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

J. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
   3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

K. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," A/E will make selection.
   5. Where products are accompanied by the term "match sample," sample to be matched is A/E's.
   6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
   7. Provide environmentally preferable products to the greatest extent possible. Provide products and materials that have a lesser or reduced effect on the environment considering raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and/or disposal of the product.

B. Product Selection Procedures:
   1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
   2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
   3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
      a. Restricted List: Where specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Substitutions for convenience will not be considered after award.
   4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
      a. Restricted List: Where specifications include a list of names, provide a product by one of the manufacturers listed that complies with requirements. Substitutions for convenience will not be considered.
   5. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches A/E's sample. A/E's decision will be final on whether a proposed product matches.
      a. If no product available within specified category matches and complies with other specified requirements, comply with provisions for “Substitutions” in the General Conditions.
   6. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, and textures" or a similar phrase, select a product that complies with other specified requirements.

a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, A/E will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, A/E will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for the following:
   1. Salvaging nonhazardous demolition and construction waste.
   2. Disposing of nonhazardous demolition and construction waste.

B. Related Sections include the following:
   1. Division 01 Section “Temporary Facilities and Controls” for
      a. Operation, terminal, and removal requirements.
      b. Location of waste containers at Project site.
      c. Control of dust and dirt during construction.
      d. Environmental protection measures during construction.
      e. Noise control during construction.
   2. Division 02 Section "Selective Structure Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.
   3. Division 04 Section "Unit Masonry" for disposal requirements for masonry waste.
   4. Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of at least 75 percent of total waste generated by the Work. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

1.4 WASTE MANAGEMENT PLANS SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed as outlined in this Section.

1. Analysis of estimated job-site waste to be generated, including types and quantities of compostable, recyclable and salvageable materials.
2. Description of means and methods to achieve required diversion rate for compostable, recyclable, and salvageable materials, including those that may be donated to charitable organizations.
3. Identification of recycling subcontractors and haulers proposed for use in the project and locations accepting construction waste materials or entities providing related services.
4. Comingled sorting facilities: Provide end destination and intended use for all diverted materials. Provide statement that project specific diversion rates will be provided. Visual inspection is not an acceptable method of inspection for purposes of documenting percentage of comingled waste diverted from landfill.
    a. Optional Compliance: Provide average annual recycling rate for the facility provided by the regulating local or state government authority.

B. Carpet Reclamation Plan: Provide directions for reclamation of recyclable carpet and carpet waste within 30 days of Contract award in compliance with Carpet Reclamation Program.
1. Carpet Reclamation Certificate: Provide verification of the carpet reclamation methods and amount (by weight or volume) diverted from landfill.

C. Acoustical Ceiling Panel Reclamation Plan: Provide directions for reclamation of recyclable acoustical ceiling panels and waste within 30 days of Contract award in compliance with applicable Reclamation Program.
1. Acoustical Ceiling Panel Reclamation Certificate: Provide verification of the acoustical ceiling panel reclamation methods and amount (by weight or volume) diverted from landfill.

1.5 MONTHLY INFORMATIONAL SUBMITTALS

A. Submit Waste Management Progress Reports monthly, with each Application for Payment. Provide, for information only:
1. Project title, name of party completing report, and dates of period covered by the report.
2. Amount (by weight or volume) of Project waste material landfilled to date and identity of the landfill(s).
3. Comingling sorting facilities: Provide summary of diversion rates, type of materials recycled and description of the end destination of the recycled materials.

1.6 CLOSEOUT SUBMITTALS

A. Final Waste Management Documentation Package: Submit at completion of construction and prior to contract close-out, in electronic format for information only. Provide:
1. All information required in Monthly Report Submittals.
2. Legible copies of on-site logs, manifests, weight tickets, and receipts.
3. Information listed above for Demolition Phase work performed under separate contract, as provided by Owner.
4. For renovation projects re-selling furniture to be included in diversion summary: Provide contract or sales receipt confirming re-sale. Furniture may be included within its own category, without breaking down the material composition unless components of the furniture are to be salvaged independently.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by A/E. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
   1. Distribute waste management plan to everyone concerned within 3 days of submittal return.
   2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
   2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

E. Facilities: Provide designated facilities for co-mingling or separation and storage of materials for recycling, salvage, reuse, return, and waste disposal, per approved Construction Waste Management Plan for use by all.
   1. Provide bi-lingual signage.
   2. Provide materials for barriers and enclosures that are nonhazardous, recyclable, or reusable to the maximum extent possible; reuse project construction waste materials if possible.
   3. Provide adequate space, convenient to subcontractors, for pick-up and delivery.
   4. Keep recycling and waste bin areas neat and clean to avoid contamination of materials.

F. Records: Maintain onsite logs for each load of materials removed from site:
   1. Landfill Log: Include type of material, load (by weight or volume), recycling/hauling service, date accepted by landfill, and facility fee.
   2. Waste Diversion: Include type of material, load (by weight or volume), recycling/hauling service, date accepted by recycling service, or non-profit receiver and facility fee.
   3. Where comingling occurs prior to collection, track the amount of construction waste diverted from landfill based on the weight or volume of the removed co-mingled waste and provide the documentation of percentages of recycled from the sorting facility.

G. Methods of waste disposal that are not acceptable are:
   1. Burning or incinerating on or off project site.
   2. Burying on project site, other than fill.
   3. Dumping or burying on other property, public or private, other than official landfill.
   4. Illegal dumping or burying.

H. Recycling Procedures:
   1. Co-mingle or separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials.
   2. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
   3. Coordinate work of recycling, composting and salvaging waste haulers with other trades.
   4. Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials to accrue to GC.

I. Reuse of materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

J. Salvage of Materials: Set aside, sort, and protect products to be salvaged for reuse offsite.

K. Alternative Daily Cover (ADC): Allowed as means of diversion.

L. Hazardous Waste Handling: Separate, store and dispose of hazardous wastes separately and in accordance with local regulations. Do not handle, separate, store, salvage, or recycle hazardous materials with other materials.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers. All sorting, managing, and documenting of construction waste shall be performed OFF-SITE ONLY using the services of a subcontractor responsible for hauling, receiving, and recycling construction waste.
1. Exceptions:
a. Concrete and site-clearing debris may be separately recycled if documentation is provided showing that at least 75 percent was diverted from landfill. Indicate quantities by weight or volume – but use same units of measure throughout the Waste Management Plan.
b. Non-Construction Waste (such as office or food-related refuse):
1) Place eligible paper and eligible beverage and food packaging in separate containers labeled for recycling and provided by the GC for use by all workers on-site.
2) Dispose of remaining non-construction waste in containers labeled for "other" non-construction waste and provided by the GC.
3) Do not hold food-related refuse more than seven days during normal weather, or more than three days if the temperature is expected to rise above 80 degrees Fahrenheit.

B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
   1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
      a. Inspect containers and bins for contamination and remove contaminated materials if found.
   2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
   4. Store components off the ground and protect from the weather.
   5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Grind asphalt to maximum 1-1/2-inch size.
   1. Crush asphaltic concrete paving and screen to comply with requirements in Division 31 Section "Earth Moving" for use as general fill.

B. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
   1. Pulverize concrete to maximum 1-1/2-inch size.
   2. Crush concrete and screen to comply with requirements in Division 31 Section "Earth Moving" for use as satisfactory soil for fill or subbase.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
   1. Pulverize masonry to maximum 1-inch size.
      a. Crush masonry and screen to comply with requirements in Division 31 Section "Earth Moving" for use as general fill.
      b. Crush masonry and screen to comply with requirements in Division 32 Section "Plants" for use as mineral mulch.
   2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.
   1. Structural Steel: Stack members according to size, type of member, and length.
   2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

G. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

H. Carpet Reclamation Procedures: Remove approved carpet materials from the existing installation and prepare for pickup by carpet manufacturer.
   1. Determine approval for carpet donation at Project Site prior to pick-up.
   2. Label for shipment according to Reclamation Program requirements.
   3. Roll or palletize and secure for shipping with shrink wrap, banding or strapping at ground level loading dock.
      a. Pallets: Minimum 40 inches by 40 inches. Palletize materials if less than a truckload.
      b. Rolls: Minimum three foot width. Maximum nine foot width.
      c. Baled materials: Not accepted.
   4. Keep materials dry and free of moisture damage, mildew or mold.

5. No materials containing asbestos or other hazardous materials accepted.
6. Prepare Fiber or Urethane carpet padding for reclamation. Attached cushion not accepted.

I. Acoustical Ceiling Tile Reclamation Procedures: Remove approved tile from the existing installation and prepare for pickup by tile manufacturer.
1. Determine approval for tile donation at Project Site prior to pick-up.
2. Label for shipment according to Reclamation Program requirements.
3. Palletize and secure for shipping with shrink wrap, banding or strapping at ground level loading dock.
   a. Pallets: 48 inches by 48 inches pallets stacked maximum 48 inches high.
4. Where the amount of approved ceiling materials is insufficient for a full trailer load, coordinate with an approved local recycler to consolidate approved ceiling materials in a secure and dry location, until a full trailer load is ready for shipment.
5. Keep materials dry and free of moisture damage, mildew or mold.
6. The following materials will not be accepted:
   a. Wood, metal, gypsum panels or construction debris of any kind.
   b. Materials containing asbestos or other hazardous materials.
   c. Panels containing fiberglass or wood fiber.
   d. Fabric-faced or vinyl-faced laminate panels.
   e. Colored or post-painted panels.
   f. Panels installed or manufactured prior to 1981.

J. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

K. Plumbing Fixtures: Separate by type and size.

L. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

M. Lighting Fixtures: Separate lamps by type and protect from breakage.

N. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

O. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:
1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Site-Clearing Wastes: Chip brush, branches, and trees at landfill facility.
1. Comply with requirements in Division 32 Section "Plants" for use of chipped organic waste as organic mulch.

C. Wood Materials:
1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

a. Comply with requirements in Division 32 Section "Plants" for use of clean sawdust as organic mulch.

D. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.
1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
a. Comply with requirements in Division 32 Section "Plants" for use of clean ground gypsum board as inorganic soil amendment.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 01 74 19

DIVISION 02

EXISTING CONDITIONS

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Demolition and removal of selected portions of building or structure.
   2. Removal and salvage of existing items for reinstallation or turn over to Owner.

B. Related Sections include the following:
   1. Division 00 Section “Supplementary Conditions” of additional video requirements.
   2. Division 01 Section "Summary" for use of premises and Owner-occupancy requirements.
   3. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
   4. Division 01 Section "Cutting and Patching" for cutting and patching procedures.
   5. Division 01 Section "Construction Waste Management and Disposal" for disposal of demolished materials.
   6. Division 01 Section "Indoor Air Quality Requirements" for monitoring and testing of indoor air.
   7. Division 06 Section “Plastic-Laminate-Faced Architectural Cabinets” for re-installation of existing casework.
   8. Division 07 Section “Roof Restoration” for any work on warranted roof.
   9. Division 10 Section “Visual Display Units” for reinstallation of existing markerboards.
   10. Division 11 Section “Vocational Shop Equipment” for re-installation of existing shop equipment.
   11. Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements.
   12. Division 31 Section “Earth Moving” for backfilling.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and place in designated areas for recycling in accordance with Waste Management Plan, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. When permitted by the A/E, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

F. Asbestos-Containing Materials (ACM): Materials containing greater than 1 percent asbestos; however, since OSHA regulates the removal of materials containing less than or equal to 1 percent asbestos even those containing less than 1 percent can be considered ACM.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner’s operations.

1.5 PREINSTALLATION MEETINGS

A. Pre-demolition Meeting: Conduct meeting at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
   5. Review areas where existing construction is to remain and requires protection.
   6. Review and finalize protection requirements.
   7. Review procedures for noise control and dust control.
   8. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.

1.6 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Survey of Existing Conditions: Submit survey.
   1. Verify selective demolition will not affect mezzanine support.

B. Schedule of Selective Demolition Activities: Indicate the following:
   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
   2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Use of elevator and stairs.
   5. Locations of proposed dust- and noise-control temporary partitions and means of egress.
   6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
   7. Means of protection for items to remain and items in path of waste removal from building.

C. Pre-demolition Photographs and/or Videos: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.
   1. Refer to Supplemental Conditions subparagraph 6.10.6 for additional information.

1.7 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.
   2. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged, if requested.

1.8 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing National Emission Standards for Hazardous Air Pollutants (NESHAP) and EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Wright State University Requirements

1. Demolition/Construction Considerations a. Any project that is to include the removal and recycling of materials such as fluorescent bulbs shall be performed in accordance with all applicable federal, state, and local rules including, but not limited to, the OEPA Universal Waste rules of OAC 3745-273. The following must occur:
    a. Prior to commencement of work the proposed recycling facility for the recycling of fluorescent bulbs shall be submitted and approved by WSU Environmental Health and Safety.
    b. Fluorescent bulbs are to be removed intact and immediately placed in contractor supplied cardboard boxes designed for the storage of fluorescent bulbs. Each box must be marked as “Universal Waste Fluorescent Bulbs” and include the date and the count of bulbs contained in the box.
    c. Full and appropriately marked boxes shall be taped closed and stored in a centralized area and marked with barrier tape and signs denoting “Universal Waste Storage Area”.
    d. Any bulbs broken during the removal and collection process must be immediately cleaned up and collected in appropriate containers acceptable for transportation and recycling by the recycling facility.
    e. The contractor is responsible for the handling and transport of bulbs to the submitted Ohio EPA listed recycler. Transportation shall be in accordance with all applicable DOT and EPA regulations.
    f. Documents showing the proper handling, transport and receipt of materials to the recycling facility must be included in the contractor’s closeout documents and shall include a copy of the recycling certificate noting the quantity of bulbs recycled. A copy of this documentation shall be forwarded to WSU Environmental Health and Safety.
    g. All costs associated with the management and recycling of fluorescent bulbs shall be the responsibility of the contractor.
2. Any project that is to include the removal and disposal/recycling of any fluorescent lamp ballasts shall be performed in accordance with all applicable federal, state, and local rules. The following must occur:
    a. Prior to commencement of work the proposed disposal or recycling facility for the disposal or recycling of fluorescent lamp ballasts shall be submitted and approved by WSU Environmental Health and Safety.
    b. Fluorescent lamp ballasts are to be removed, wires clipped from the ends, and collected in appropriate DOT approved containers.
    c. The contractor is responsible for the handling and transport of fluorescent lamp ballasts to the submitted approved disposal or recycling facility. Transportation shall be in accordance with all applicable DOT and EPA regulations.
    d. Documents showing the proper handling, transport and receipt of fluorescent lamp ballasts to the disposal or recycling facility must be included in the contractor’s closeout documents and shall include a copy of the disposal or recycling certificate noting the quantity of ballasts disposed or recycled. A copy of this documentation shall be forwarded to WSU Environmental Health and Safety.
    e. All costs associated with the management, disposal and/or recycling of fluorescent lamp ballasts shall be the responsibility of the contractor.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
    1. Comply with requirements specified in Division 01 Section "Summary."

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
    1. Owner will remove items indicated before selective demolition.

C. Notify A/E of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify A/E and Owner. Owner will remove hazardous materials under a separate contract, unless otherwise noted.
   2. Any hazardous material brought on-site during demolition or construction activities, including fuel in aboveground storage tanks, must be stored within secondary containment devices and a material safety data sheet must be submitted to WSU Environmental Health and Safety.
   3. Any hazardous material brought on-site by the contractor must be removed from university property at the end of the project and properly disposed of in compliance with EPA Standards. The university reserves the right to dispose of any hazardous material left behind at the expense of the contractor.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 COORDINATION

A. Arrange selective demolition schedule to as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations at authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

B. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to A/E.

D. Engage a professional engineer to perform an engineering survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
   1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 PREPARATION

A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and

finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

B. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition aera and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surface and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section “Temporary Facilities and Controls”.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."
2. Maintain fire-protection facilities in service during selective demolition operations.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.4 SALVAGE/REINSTALL

A. Removed and Salvaged Items:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

B. Removed and Reinstalled Items:
1. Clean and verify items are in functional condition adequate for intended reuse. If items are not in workable condition notify A/E and Owner before removal. Record condition of existing equipment at time of removal along with installation methods.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches.
5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
8. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal."

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by A/E, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete adjacent to Construction Indicated to Remain: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
1. Carefully remove existing brick ledge, where indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
1. Remove full size CMU without cutting, if possible, at areas to be patched. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before patching. Install units with cut surfaces and, where possible, cut edges concealed.

2. Contractor Option: In lieu of utilizing new brick where brick is to be matched Contractor may remove in an undamaged condition as many whole bricks as possible.
    a. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
    b. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
    c. Store brick for reuse. Store off ground, on skids, and protected from weather.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove, unless otherwise noted.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI, unless otherwise noted.
    a. Do not utilize chemical agents.

E. Carpeting: During removal maintain ventilation at maximum capacity.
1. Vacuum used carpet before removal for reuse.
    a. Use a vacuum bearing the CRI Seal of Approval “Green Label”. This label identifies vacuums that have been tested and meet minimum standards for dust containment, soil removal, and carpet appearance retention.
2. Remove carpet tile as required to accommodate new work and pack neatly in container for reuse. Deposit only clean, dry carpet in containers. “Clean” is defined as free from demolition debris, asbestos contamination, garbage, and tack strips.
    a. Remove adhesive according to recommendations of the Carpet and Rug Institute (CRI).
3. Vacuum the floor immediately after old carpet has been removed.
4. Continue operating the ventilation system at normal room temperature for up to 72 hours.

F. Acoustical Ceiling Panels:
1. Slavage and reuse undamaged acoustical ceiling materials. Palletized in a manner allowing for safe storage.
    a. 4 by 4 feet pallets stacked with ceiling materials to 4 feet tall each and then stacked on top of each other in the trailer.
2. Pallets must be kept dry.

G. Fluorescent light fixture components shall be removed and recycled/incinerated as required by Article 1.8 paragraph B. and as follows:
1. Remove and store non-leaking non-electronic ballasts in sealed or labeled metal drums.
2. Remove and store leaking non-electronic ballasts in separate sealed and labeled metal drums.
3. Remove and store fluorescent lamps in cardboard lamp boxes labeled “Mercury Lamps for Recycling.” Lamps shall remain intact.
4. Lamps and ballasts shall be transported to an EPA approved recycler. Non-electronic ballasts shall be incinerated. All other components may be recycled.

H. Explosives: Use of explosives or cutting torches is not permitted.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.
   1. All asbestos waste is to be disposed of in accordance with 40 CFR Part 61.150 of the NESHAP standard.

3.8 CLEANING/PATCHING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

B. Repair demolition performed in excess of that required. Return structures, substrates, and surfaces to remain to condition existing prior to commencement of selective demolition work. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.
   1. Refer to Division 01 Section “Cutting and Patching”.

3.9 SELECTIVE DEMOLITION SCHEDULE

A. Refer to Demolition Drawing Sheets applicable to Construction Contract for the indication of specific materials to be salvaged and for materials to be removed for reuse.

B. Review and be fully aware of the demolition work under other trades and coordinate activities between them.

C. Existing Items to Be Removed and Reinstalled:
   1. Tackboard and markerboard, where indicated
   2. Casework, where indicated.
   3. Vocational Shop Equipment as indicated.
   4. Carpet tile, as indicated.
   5. Acoustical ceiling panels (undamaged) , as indicated.
   6. Wood doors, as indicated.
   7. AED, as indicated.
   8. Accessible parking signs.
   9. Staff parking signs.

D. Existing Items to be Salvaged and turned over to Owner:
   1. AV Projector.
   2. Refrigerator
   3. Fire extinguisher.

END OF SECTION 02 41 19

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for following:
   1. Exterior Concrete
      a. Stoops (Frost Slab)
      b. Miscellaneous items including
         1) Light pole bases
         2) Equipment pads
         3) Lean concrete backfill
   2. Interior Concrete
      a. Slab-on-ground
      b. Bases, curbs
      c. Foundations, footings, pads, piers
   3. Provide other cast-in-place concrete and related work as indicated for complete and finished work, except concrete work specifically designated to be provided under Work of other Sections of these Specifications.

B. Related Sections include following:
   1. Division 05 Section “Metal Fabrications” for coordination with embedded edge angle.
   2. Division 07 Section “Thermal Insulation” for underslab perimeter insulation.
   3. Division 07 Section “Joint Sealants” for sealing joints and penetrations in slab-on-grade or slabs below grade.
   4. Division 09 Finish sections for coordination with substrate requirements of finish materials.
   5. Division 31 Section "Earth Moving" for underslab subgrade.
   6. Division 32 Section "Concrete Paving" for concrete pavement and walks.

1.2 DEFINITIONS

A. Cementitious Materials: Materials that have cementing value if used in concrete, including Portland cement alone or in combination with fly ash; subject to compliance with requirements.

B. Mineral Fillers: Finely ground inert materials that are used to help the water to powder ratio and are used to supplement cementitious materials.

C. Water-Cementitious Materials Ratio (w/cm): Ratio by weight of water to cementitious materials, excluding that absorbed by aggregate, stated as a decimal.

D. Form-Facing Material: Temporary structure or mold for support of concrete while concrete is setting and gaining sufficient strength to be self-supporting.

E. Formwork: Total system of support of freshly placed concrete, including mold or sheathing that contacts concrete, as well as supporting members, hardware, and necessary bracing.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate with other trades to maintain protection of concrete surfaces scheduled to receive special concrete finish or remain exposed. Protect concrete surfaces from physical damage and staining that could result from subsequent construction operations and might compromise final concrete finish.

B. Pre-installation Meeting: Conduct meeting(s) at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Note: In lieu of one pre-installation meeting as work progresses, additional pre-installation meetings might need to take place to facilitate installation sequences i.e., footing and foundations, slab-on-grade, and elevated slabs.
   1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including following:
      a. Contractor's superintendent.
      b. Independent testing agency for special inspection and testing and inspecting agency procedures for field quality control.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor, including finisher.
      e. Special concrete finish subcontractor.
   2. Review the following:
      a. Construction joints, control joints, isolation joints, and joint-filler strips
      b. Vapor-retarder installation
      c. Anchor rod and anchorage devices installation tolerances
      d. Concrete mixtures-specification and constructability requirements
      e. Scheduling and details of placement
      f. Contract information of responsible persons during placement
      g. Placement procedures and rate of placement
      h. Jobsite adjustments permitted and decision process
      i. Cold and hot weather requirements
      j. Concrete finishes and finishing
      k. Curing procedures
      l. Methods for achieving specified floor and slab flatness and levelness
      m. Floor and slab flatness and levelness measurements
      n. Concrete repair procedures
      o. Concrete protection
      p. Special inspection and testing and inspecting agency procedures for field quality control.
      q. Testing frequency, sampling location

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including the following, if used for concrete mixtures:
   1. Form coatings
   2. Portland cement
   3. Fly ash
   4. Aggregates
   5. Include installation instructions where applicable.
      a. Vapor Barrier: Manufacturer’s installation instructions for placement, seaming, penetration prevention and repair, and perimeter seal per ASTM E1643.
   6. Admixtures: Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature of time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
   7. Curing materials
   8. Floor and slab treatments
   9. Joint fillers
   10. Repair materials

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Prepare and submit design mixes for each type of concrete and flowable fill. Use an independent testing facility acceptable to A/E for testing compressive strength of proposed mix designs. Submit compression test results for each design mix used to document that proposed mixture will achieve the required average compressive strength and other specified requirement. Test report shall clearly indicate design mix for which it applies. Each design mix shall indicate types of structures in which it is to be used.
   1. Field test records for concrete strength test records must be from concrete supplied from the same production facilities proposed for work. Test data shall be from concrete mixtures containing similar materials proposed for work, including:
      a. Minimum 28-day compressive strength
      b. Maximum w/cm
      c. Slump limit
      d. Air content
      e. Nominal maximum aggregate size
   2. Strength test reports for establishing a standard deviation for each class of concrete or for documenting the required average strength for work shall not be greater than 24 months old and shall be collected over a period not less than 45 days.
   3. Indicate amounts of mixing water to be withheld for later addition at Project site.
      a. Note: A workability retaining admixture may also be used.
   4. Sample design mix submittal form is enclosed herein.

C. Steel Reinforcement Shop Drawings: Comply with ACI SP-066:
   1. Placing drawings that detail fabrication, bending, and placement.
   2. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
   3. Indicate strength, size, and details of all bar reinforcing, and style and specification of all welded wire fabric. Details must indicate clear cover used to determine chair heights.

D. Construction Joint Layout: Indicate proposed construction joints required to construct structure.
   1. Location of construction joints is subject to approval of A/E.

E. Concrete Schedule: For each location of each class of concrete indicated in “Concrete Mixtures” article, include following:
   1. Location within project.
   2. Exposure class designation.
   3. Formed surface finish designation and final finish. Final finish for floors.
   4. Curing process.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Qualification Data: For installer, manufacturer , and testing agency.
   1. Installer: Include copies of applicable ACI certificates or NRMCA Certification.
   2. Testing agency retained by the contractor for field quality control: Include conformance to ASTM C1077 or ASTM E329 and copies of ACI certificates of testing technicians.

B. Material Test Reports: For following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

C. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

D. Proposed curing schedule shall include method and duration.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician or equivalent.
   1. When requested, the Installer shall furnish a Quality Control Plan.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities", certification or approval by a state or highway agency or equivalent. Criteria of equal certification shall be included in the submittal.
   2. Quality control personnel with responsibility for concrete mixtures certified as an NRMCA Concrete Technologist Level 2, or equivalent. Criteria of equivalent certification shall be included in the submittal.
   3. When requested, the manufacturer shall furnish a Quality Control Plan.

C. Environmental Requirements: Manufacturer and Contractor shall conform to Federal, State, and Local V.O.C. (Volatile Organic Compound) Regulations in area where Project is located. Notify A/E in writing if variations to Specifications herein are required.

D. Laboratory Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing including mix design.

E. Regulatory Requirements: Comply with requirements of latest edition or edition approved by authorities having jurisdiction.
   1. ACI Publications: Comply with following unless modified by requirements in Contract Documents:
      a. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
      b. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
      c. ACI 347 “Recommended Practice of Concrete Formwork.”
      d. ACI 318, “Building Code Requirements for Structural Concrete.”
      e. ACI PRC-211.1 "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete."
      f. ACI PRC-212.3 “Report on Chemical Admixtures for Concrete.”
      g. ACI PRC-302.1 "Guide for Concrete Floor and Slab Construction."
      h. ACI PRC-304 "Guide for Measuring, Mixing, Transporting, and Placing Concrete."
      i. ACI SPEC-305.1 “Specification for Hot Weather Concreting.”
      j. ACI SPEC-306.1 “Standard Specification for Cold Weather Concreting.”
      k. ACI SPEC-308.1 “Specification for Curing Concrete.”
      l. ACI PRC-311.4 "Guide for Concrete Inspection."
   2. Concrete Reinforcing Steel Institute, “Manual of Standard Practice”.
   3. ASTM Intl.:
      a. ASTM A 1064 “Standard Specification for “Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.”
      b. ASTM C33 “Standard Specification Curing Concrete.”
      c. ASTM C94 “Standard Specification for Ready-Mix Concrete.”
      d. ASTM C138 “Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.”
      e. ASTM C156 “Standard Test Method for Water Loss Through Liquid Membrane-Forming Curing Compounds for Concrete”.
      f. ASTM C260 “Standard Specification for Air Entraining Admixtures for Concrete.”
      g. ASTM C494 “Standard Specification for Chemical Admixtures for Concrete.”
      h. ASTM C309 “Standard Specification for Liquid Membrane – Forming Compounds for Curing Concrete.”
      i. ASTM C779 “Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.”

j. ASTM C989 “Standard Specification for Slag Cement for Use in Concrete and Mortars.”
k. ASTM C1315 “Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.”
l. ASTM E1155 “Determining Floor Flatness and Levelness Using F-Number System.”
m. ASTM F609 “Standard Test Method for Using a Horizontal Pull Slip Meter (HPS).”

F. Concrete ramps and curbs shall be provided to conform to Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local Regulations. These requirements supersede Technical Specifications in this Section.
1. Detectable warnings shall conform to ADAAG.

G. Mockups: Cast concrete slab-on-grade panels to demonstrate typical joints, surface finish, texture, and standard of workmanship.
1. Slab-On-Ground build panel approximately 225 sq.ft. (area within one set of control joints) in location indicated or, if not indicated, as directed by A/E.
a. Divide panel into four equal panels to demonstrate saw joint cutting.
2. Formed Surfaces: Build panel approximately 100 sq.ft. in location indicated or, if not indicated, as directed by A/E.
3. Approval panels may become part of completed work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Concrete: Comply with ASTM C94 and ACI SPEC-301.
1. Delivery tickets to contain the following, in addition to the information required by C94:
a. Reading of revolution counter at first addition of water.
b. Type and brand of cement and supplementary cementitious materials.
c. Cementitious content.
d. Total water content by producer.
e. Maximum size of aggregate.
2. ASTM C94 requires discharge within 1-1/2 hours or 300 revolutions; whichever comes first, after the introduction of water to cement and aggregates, or the introduction of cement to aggregates. A/E may require an earlier discharge during hot water, or when high-early strength cement is being used.

B. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
1. Store reinforcement to avoid contact with earth.

C. Vapor Barrier:
1. Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
2. Store materials in a clean, dry area in accordance with manufacturer’s instructions.
3. Protect materials during handling and application to prevent damage or contamination.

D. Curing Compounds and Liquid Flour Treatments:
1. Deliver materials in original containers, with seals unbroken, being manufacturer labels indicating brand name and directions for storage.

1.8 FIELD CONDITIONS

A. Environmental Requirements.
1. Floor and Slab Treatments: Follow manufacturer’s recommendations for environmental requirements when using floor and slab treatments.
a. Do not apply concrete densifier and chemical hardener when concrete temperature is below 35 degrees F or above 135 degrees F.

B. Cold-Weather Placement: Comply with ACI SPEC-301 and ACI SPEC-306.1 and as follows:
   1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperature.
   2. When average high and low temperature is expected to fall below 40 deg. F for three successive days, maintain delivered concrete mixture temperature within temperature range required by ACI SPEC-301.
   3. Do not use frozen materials or materials containing ice or snow. Do not place concrete in frozen subgrade or on subgrade containing frozen materials.
   4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
   5. Do not place concrete in contact with surfaces less than 35 deg F., other than reinforcing steel.

C. Hot-Weather Placement: Comply with ACI SPEC-301 and ACI SPEC-305.1 and as follows:
   1. Maintain concrete temperature below 95 deg. F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without sanding water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of manufacturers specified.
   2. Products: Subject to compliance with requirements, provide one of products specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed material requirements and functional qualities of specified product. Requests for A/E's approval must be accompanied by "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain all concrete mixtures from same ready mixed concrete manufacturer for entire Project.
   1. All cement to be from same mill.

2.2 CONCRETE, GENERAL

A. ACI Publications: Comply with following, unless modified by requirements in Contract Documents:
   1. ACI SPEC-301
   2. ACI SPEC-117

2.3 FORM-FACING MATERIALS

A. Smooth-Formed Finished (Exposed) Concrete Form-Facing Material (As-Cast Surface): Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, fiberglass, or other approved panel materials.

B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

C. Chamfer Strips: Metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
   1. Products:
      a. Greenstreak 622; Greenstreak
      b. Vinylex CSN-3/4; Vinylex Corp.
      c. CHM-75-75-110 Poly-Comp Plastic Chamfer; Sylvan Products
      d. CS-750 Chamfer Former; BoMetals Inc.

D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
   2. Products: Subject to compliance with requirements, provide one of following:
      a. MasterFinish RL Series; Master Builders Solutions.
      b. Crete-Lease 20-VOC; Cresset Chemical Co.
      c. Clean Strip J1EF; Dayton Superior Corporation
      d. Asphalt Release; Franmar Chemical, Inc.
      e. Bio-Form; Leahy-Wolf Co.
      f. Soy Form Release and Natural Form Oil: Natural Soy, LLC
      g. SOYsolv; SOYsolv
      h. Formshield WB; Tamms Industries
      i. SealTight Duogard II; W.R. Meadows, Inc.
      j. Easy Strip Form Releaser; Formex
      k. L&M EZ Strip; Laticrete

E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 inch to plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.4 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed for bars No. 3 to 11, unless otherwise noted.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets. Note: Roll stock is not acceptable.

2.5 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
   1. Use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports as recommended for application indicated.

2.6 CONCRETE MATERIALS

A. Source Limitations: Obtain each type of class or cementitious material of same brand from same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Material: Use cementitious materials, of same type, brand, and source, throughout Project. Supplement cement as necessary to meet project conditions.
   1. Coordinate with mix design for special finishes.
   2. Portland Cement: ASTM C 150, Type I or III, gray.
   3. Limit fly ash to Class F if concrete expansion from alkali silica are anticipated.
      a. Fly Ash: ASTM C 618, Class C or F.

C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, uniformly graded not to exceed 1-1/2 inch nominal size per ACI 301. Provide aggregates from a single source to ensure uniformity in color, size, and shape with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Aggregates shall not be potentially reactive as defined in Appendix X1 of ASTM C33.
   1. Local aggregates not complying with ASTM C33, but which have shown by special test or actual service to produce concrete of adequate strength and durability, may be used when acceptable to A/E.
   2. Fine Aggregate: Clean, sharp, natural sand free from loam, clay lumps, or other deleterious substances.
   3. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
      a. Crushed stone, processed from natural rock or stone.
      b. Washed gravel, either natural or crushed. Use of pit or bank-run gravel is not permitted.
      c. Maximum Aggregate Size: Not larger than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourths of minimum clear spacing between individual reinforcing bars or bundles of bars.
      d. Exterior concrete shall have crushed limestone aggregate, complying with ASTM C33, Class 4S or better.
   4. Alkali-Silica Reaction: Comply with one of following:
      a. Expansion Result of Aggregate: 14-day expansion less than or equal to 0.10 percent when tested in accordance with ASTM C 1260, or not more than 0.04 percent at one-year when tested in accordance with ASTM C 1293.
      b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C 1567. Do not use this option with fly ash with an alkali content greater than 4.0 percent. Submit supporting data for each aggregate showing expansion in excess of 0.10 percent when tested in accordance with ASTM C1260.
      c. Alkali Content in Content in Concrete: Not more than 4 lb./cu.yd. for moderately reactive aggregate or 3 lb./cu.yd. for highly reactive aggregate, when tested in accordance with ASTM C 1293 and categorized in accordance with ASTM C 1778, based on alkali content being calculated in accordance with ACI SPEC-301. Calculate alkali content of concrete in accordance with ACI 301. Do not use this option with natural pozzolan or fly ash that has a calcium oxide content greater than 18 percent or an alkali content greater than 4.0 percent; or for an aggregate with expansion at one year greater than or equal to 0.24 percent when tested in accordance with ASTM C1293.

D. Combined aggregate gradation for slabs and other designated concrete shall be 8%-18% for large, top size aggregates (1-1/2 inch) or 8%-22% for smaller, top size aggregates (1 inch or 3/4 inch) retained on each sieve size below top size and above No. 100.

E. Water: ASTM C1602.

2.7 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260 as indicated in Article ”Concrete Mixtures for Building Elements”.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Admixtures containing intentionally added chlorides shall conform to limit consistent with ACI 318 and ACI 301.
   1. Water-Reducing Admixture: ASTM C 494, Type A.
   2. Retarding Admixture: ASTM C 494, Type B or D.
   3. Accelerating Admixture: ASTM C 494, Type C or E.
   4. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
   5. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
   6. High-Range, Water-Reducing Admixture: ASTM C 494, Type F or G.
   7. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
   8. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
   9. Workability-Retaining Admixture: ASTM C494, Type S. Shall retain concrete workability without affecting time of setting or early-age strength development.
   10. ASR-Inhibiting Admixtures: ASTM C494, Type S. Shall contain a nominal lithium nitrate content of 30 percent.
   11. Other Specific Performance Admixtures: ASTM C494, Type S.
   12. Admixtures with no standard (ASTM or other) designation shall be used with the permission of the engineer of record when its use for specific properties is required and can be submitted with documentation that demonstrates appropriate testing.

2.8 VAPOR BARRIER

A. Vapor Barrier:
   1. Plastic Vapor Barrier
      a. Water Vapor Barrier: ASTM E-1745; meets or exceeds Class A.
      b. Permeance Rating: ASTM E-96 or ASTM F 1249; 0.01 Perms or less.
      c. Thickness of Barrier: ACI 302.2R-06; not less than 15 mils.
      d. Puncture resistance greater than or equal to 3,000 grams tested by ASTM D1709.
      e. Tensile strength greater than or equal to 65 lbf/in tested by ASTM E1745.
      f. Chemical Resistance “Unaffected” tested by ASTM E154.
   2. Products:
      a. Stego Wrap (15 mil) Vapor Barrier; Stego Industries
      b. VaporBlock 15/VaporBlock G; Raven Industries
      c. Perminator (15 mil); W.R. Meadows
      d. Viper Vaporcheck II (15 mil); Insulation Solutions Inc.
      e. Barrier-Bac VB-35 16 mil); Interplast
      f. Husky Yellow Guard (15 mil); Poly-America
      g. Tex-Trude Xtreme Vapor Barrier (15 mil); Tex-Trude, LP

B. Vapor Barrier Accessories
   1. Seam/Transition Tape: Tape with pressure sensitive adhesive or double-sided adhesive. Minimum width 4 inches.
   2. Construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer’s instruction.

C. Drainage Fill (Coarse):
   1. Narrowly graded mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448; ODOT Item No. 304, Aggregate Base; with 100 percent passing a 2-inch sieve and 90 to 33 percent passing a No. 30 sieve.

2.9 FLOOR AND SLAB TREATMENTS

A. Pigmented Mineral Dry-Shake Floor Hardener (DSCH): Factory-packaged, dry combination of Portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides inter-ground with cement.
   1. Products:
      a. Concolor; ChemMasters.
      b. Quartz Tuff; Dayton Superior Corporation.
      c. Surflex; Euclid Chemical Company (The).
      d. Tycron; Kaufman Products, Inc.
      e. Colorhard; Lambert Corporation.
      f. Quartz Plate FF; Laticrete International, Inc.
      g. MasterTop 100; Master Builders Solutions.
      h. Floor Quartz; Metalcrete Industries.
      i. Lithochrome Color Hardener; Scofield, L. M. Company.
      j. Quartz Floor Hardener, SpecChem, LLC
   2. Color: As indicated in “List of Finishes.

2.10 CURING MATERIALS

A. Curing and sealing compounds shall comply with testing and product requirements of California Department of Public Health’s “Standard Method for Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers”.

B. Evaporation Reducer: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
   1. Products:
      a. Spray-Film; ChemMasters.
      b. AquaFilm; Dayton Superior Corporation.
      c. Eucobar; Euclid Chemical Company (The).
      d. Vapor Aid; Kaufman Products, Inc.
      e. Lambco Skin; Lambert Corporation.
      f. E-Con; Laticrete International, Inc.
      g. MasterKure ER 50; Master Builders Solutions.
      h. Evapre; Meadows, W. R., Inc.
      i. Waterhold; Metalcrete Industries.
      j. Monofilm; Nox-Crete Products Group, Kinsman Corporation.
      k. SikaFilm; Sika Corporation, Inc.
      l. Certi-Vex EnvioSet; Vexcon Chemicals, Inc.
      m. TK-2120 TRI-FILM; TK Products, Division of Sierra Corp.
      n. AntiVap; SINAK Corporation
      o. SpecFilm, SpecChem, LLC

C. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

D. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
   1. Color:
      a. Ambient Temperature below 50 deg. F.: Black.
      b. Ambient Temperature between 50 deg F. and 85 deg F.: Any color or clear.
      c. Ambient Temperature above 85 deg F.: White.

E. Curing Paper: Eight feet wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
   1. Basis-of-Design: Henry Company; a Carlisle Company.

F. Water: Potable or complying ASTM C1602 that does not cause staining of the surface.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. Compounds will need to be abrasively removed by applicator. Product maybe used unless prohibited in PART 3 Execution, Article “CONCRETE PROTECTING AND CURING”.
   1. Products:
      a. AH Curing Compound #2 DR WB; Anti-Hydro International, Inc.
      b. Safe-Cure Clear; ChemMasters.
      c. Clear Resin Cure J11W or Clear Cure VOC J7WB; Dayton Superior Corporation.
      d. Kurez DR VOX, TAMMSCURE WB 30C; Euclid Chemical Company (The).
      e. Thinfilm 420; Kaufman Products, Inc.
      f. Aqua Kure-Clear; Lambert Corporation.
      g. L&M Cure R; Laticrete International, Inc.
      h. 1100 Clear; Meadows, W. R., Inc.
      i. Resin Cure E; Nox-Crete Products Group, Kinsman Corporation.
      j. Clear Water Resin; Right Pointe.
      k. E-Cure or Spec Rez; SpecChem, LLC.
      l. Certi-Vex Enviocure 100; Vexcon Chemicals, Inc.
      m. TK-2519 DC WB; TK Products, Division of Sierra Corp.

H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound (CSC): ASTM C 1315, Type 1, Class A. Use only where slabs receive no other type of coating or finish.
   1. Products:
      a. Polyseal WB; ChemMasters.
      b. Cure & Seal 1315 J22WB; Dayton Superior Corporation.
      c. Super Diamond Clear VOX; LusterSeal WB300; Euclid Chemical Company (The).
      d. Sure Cure 25 Emulsion; Kaufman Products, Inc.
      e. UV Safe Seal; Lambert Corporation.
      f. Lumiseal WB Plus; Laticrete International, Inc.
      g. Vocomp-30; Meadows, W. R., Inc.
      h. Metcure 30; Metalcrete Industries.
      i. Right Sheen WB 30; Right Pointe.
      j. Vexcon Starseal 1315; Vexcon Chemicals, Inc.
      k. Cure & Seal WB 25; SpecChem, LLC

2.11 SEALERS

A. Penetrating Anti-Spalling Sealer (Exterior stoops): Sealer shall be a siloxane-based compound or silane modified siloxane emulsion formulated to reduce chloride ion absorption/intrusion by 80 percent when tested in accordance with NCHRP #244, Test Method Series II or IV tests. In addition, sealer-treated concrete shall exhibit no scaling when exposed to 125 cycles of freezing and thawing when tested in accordance with ASTM C 672. Tests shall be by an independent testing laboratory.
   1. Products:
      a. Baracade Silane 100c; Euclid Chemical
      b. Baracade Silane 40; Euclid Chemical (lower area coverage rate per gallon)
      c. Aquanil Plus 100; Chemmasters
      d. Aquanil Plus 40 A; Chemmasters (lower area coverage rate per gallon)
      e. Specsilane 100; Specchem LLC
      f. Specsilane 40; Specchem LLC (lower area coverage rate per gallon)

B. Floor Sealer: ASTM C1315, Type I, Class A and ASTM C309, Type I, Class A and B. Acrylic water-based urethane clear sealer, non-yellowing, resistant to blush, and satin finish as recommended by manufacturer for preventing staining by waterborne and oil substances.
   1. Products:
      a. Everclear VOX (Acrylic Sealer); Euclid Chemical Co.
      b. Cure and Seal 1315 EF; Dayton Superior
      c. Polyseal WB; ChemMasters
      d. Cure & Seal WB 25; SpecChem LLC

2.12 ACCESSORIES

A. Expansion and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, ASTM D 1752, cork or self-expanding cork, or ASTM 4819, Type II, or ASTM D 1622 closed-cell compressible foam, 1/4-inch maximum thickness.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Floor Slab Protective Covering: Eight feet with cellulose fabric.
   1. Basis-of-Design: McTech Group, Inc. or a comparable product as recommended by a specialty concrete finish manufacturer.

2.13 REPAIR MATERIALS

A. Epoxy Crack Injection Adhesive (Repair): ASTM C881, Type I, Grade 1, solvent free.
   1. Products:
      a. Sikadur 35 Hi-Mod LV; Sika Corp.
      b. EUCO #452 LV; Euclid Chemical Co.
      c. MasterInject 1380; Master Builders Solutions.
      d. Pro-Poxy 100; Unitex
      e. SpecPoxy 1000; SpecChem, LLC

B. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.
   5. Products:
      a. Ardex K-15; Ardex Inc.
      b. Econolevel; Dayton Superior Corporation.
      c. MasterTop 110SL; Master Builders Solutions.
      d. Skimflow ES; Dependable Chemical Co., Inc.
      e. EZ Level; TEC Specialty Products.
      f. Super FLO TOP; Euclid Chemical Co.
      g. Levelex; L & M Construction Chemical.
      h. Custom Building Products; CustomTech TechLevel 150
      i. LEVELEZ; Maxxon Corp.
      j. Schonox US; Schonox HPS North America
      k. SpecFlow; SpecChem, LLC

C. Repair Overlayment (Traffic-Bearing): Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.
5. Products:
    a. Level Topping; Dayton Superior
    b. Duracrete; L & M Construction
    c. Wearflow; Dependable Chemical Co. Inc.
    d. Ardex SD-T or K500; Arden Americas.
    e. Custom Building Products; CustomTech TechLevel-HPT High Performance Topping.
    f. SpecLevel-Gray SpecChem, LLC

2.14 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI SPEC-301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
2. The installer and manufacturer shall coordinate to establish properties of the fresh concrete to facilitate placement and finishing with reduced potential for segregation and bleeding. Factors shall include but are not limited to slump or slump flow, setting time, method of placement, rate of placement, hot and cold weather placement, curing, and concrete temperature. Selection of fresh concrete properties shall be notified to the Engineer of Record in the submittal.
3. Contractor shall indicate reportable changes in sources of materials and quantities when such changes are necessary to ensure constructability, performance of concrete and compliance with the specification requirements. The Contractor is permitted to make minor adjustments less than the reportable deviations noted in the original submittal to concrete mixtures to ensure uniformity of concrete without a resubmittal for review or approval.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
1. Fly Ash: 25 percent, unless otherwise recommended by ready mix manufacturer and approved in mix design by A/E.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cementitious materials.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing and accelerating admixture when required by low temperatures or cold-weather placement conditions.
4. Use water-reducing admixture in pumped concrete with a water-cementitious materials ratio below 0.50.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Exterior Concrete (Stoops and miscellaneous items, including but not limited to light pole bases and equipment pads): Proportion normal-weight concrete with following properties:
1. Compressive Strength (28 days): Refer to Division 03 Section “Concrete Schedule”.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: Refer to Division 03 Section “Concrete Schedule”.

3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content 6.0 percent, plus or minus 1.0 percent at point of delivery for concrete containing 3/4 inch nominal maximum aggregate size.

B. Footings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: Refer to Division 03 Section “Concrete Schedule”.
2. Maximum Water-Cementitious Materials Ratio: Refer to Division 03 Section “Concrete Schedule”.
3. Slump Limit: Not less than one inch and not more than 3 inches.

C. Foundation Walls and Retaining Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: Refer to Division 03, Section “Concrete Schedule”.
2. Maximum Water-Cementitious Materials Ratio: Refer to Division 03, Section “Concrete Schedule.
3. Slump Limit: Not less than one inch and not more than 3 inches.
4. Air Content: 6.0 percent, plus or minus 1.0 percent at point of delivery for concrete containing 3/4 inch nominal maximum aggregate size.

D. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: Refer to Division 03, Section “Concrete Schedule”.
2. Slump Limit: 4 inches, plus or minus 1 inch, before adding water-reducing or plasticizing admixtures, with maximum slump less than 6 inches.
3. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

2.16 PROPORTIONING AND DESIGN OF MIXES

A. Proportion mixes by either laboratory trial batch or field experience methods as specified in ACI SPEC-301, using materials to be employed on project for each class of concrete required.

B. Submit written reports to A/E of each proposed mix for each type of concrete at least 15 days prior to start of Work. Indicate with each mix design items or structures for which it is to be used. Do not begin concrete production until mixes have been reviewed by A/E. Submit following information:
1. Complete identification of aggregate source of supply.
2. Tests of aggregates for compliance with specified requirements.
3. Scale weight of each aggregate.
4. Absorbed water in each aggregate.
5. Brand, type, and composition of cement with product information.
6. Brand, type, and amount of each admixture with product information.
7. Amounts of water used in trial mixes.
8. Proportions of each material per cu.yd., including fibrous secondary reinforcement, if used.
9. Gross weight and yield per cu.yd. of trial mixtures.
10. Measured slump, with and without water reducer, if used.
11. Measured air content.
12. Submit compressive strength results from tests performed by an independent testing agency on at least 30 consecutive strength tests or two groups of tests totaling at least 30 within past 12 months. Supply standard deviation and average strength in accordance with ACI SPEC-301.
13. Identification number or name of mix to verify agreement with compression test reports.
14. Water/Cementitious Materials Ratio

C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by A/E. Laboratory test data for revised mix designs and strength results shall be submitted to and must be accepted by A/E before using in work.

D. Maximum Water-Cementitious Materials Ratio: Concrete mixes shall be limited to water-cement ratios specified in Concrete Schedule in these Specifications (Division 03 Section “Concrete Schedule”). Water reducers and SCM’s may be used to increase slump while maintaining or reducing water-cementitious materials ratio at or below maximums specified values, except where specifically prohibited in these specifications.

2.17 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.18 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and furnish batch ticket information.
   1. Addition of water to batch will be permitted only to regain target slump for particular mix design or with verification that design water/cement ratio has not been exceeded and only under direct control of concrete testing agency field representative. All water added at site to be noted on concrete field inspection report. All tests on concrete to be performed after water is added.
   2. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
   3. Mix proprietary materials in accordance with manufacturer’s instructions, including product data and product technical bulletins.
      a. Once specific mix design and sequencing of raw materials have been established, do not alter. Consistency of raw materials in each phase of mixing is most important element in making quality concrete.

B. Project-Site Mixing: Not permitted without prior approval of A/E in writing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive concrete sealer. Do not apply over curing compounds. Notify A/E if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 PREPARATION

A. Preplacement Observation: Before placing concrete, observe and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other trades to permit installation of their work; cooperate with other trades in setting such work, as required.
   1. Observe soil at bottom of foundation systems, which will be subject to testing for soil bearing value by testing laboratory, as directed by A/E. Place concrete immediately after approval of foundation excavations.
   2. Observe underslab drainage course areas that were subject to testing for soil bearing value by testing laboratory as required by A/E. Place concrete immediately after approval of underslab compaction tests.
   3. Remove all debris from forms and deck. Clean steel deck of grease, oil, and other substrates that would reduce bond to concrete.
   4. Standing water shall be removed from place of deposit before concrete is placed.
   5. Do not use additives or salts to remove ice. Non-chloride deicers may be used.

B. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
   1. Daily access to the work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Security and protection for samples and for testing and inspection equipment at Project site.

C. Material placement for interior slabs on grade and exterior concrete stoops.
1. Install and properly support and anchor slab welded wire fabric.
2. Position expansion joint fillers where indicated and as recommended by manufacturer. Special precautions shall be taken to avoid collapse during installation.

D. Under slabs-on-grade, place drainage course on prepared subbase and as follows:
1. Place drainage course on subgrades free of mud, frost, snow, or ice.
2. Compact drainage course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

E. Clean surfaces to receive coatings. Remove loose and foreign matter that could interfere with application or performance of sealer.

3.3 FORMWORK INSTALLATION

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to required shapes, lines, and dimensions.
1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
3. Contractor responsible for foundations is responsible to verify from Geotechnical Engineering Report included in this Project Manual that soil conditions allow use of earth-formed foundations. If soil conditions do not allow earth-forming, Contractor shall include cost of forming foundations in his bid.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347as abrupt or gradual, as follows:
1. Class A, 1/8 inch for smooth-formed finished surfaces, where exposed to view.
2. Class C, 1/2 inch for rough-formed finished surfaces, unless otherwise noted.
3. Variation from plumb in lines and surfaces of columns, piers, walls, and arrises; 1/4 inch per 10 feet, but not more than 1 inch. For exposed corner columns, control joint grooves, and other conspicuous lines, 1/4 inch in a bay or 20 feet maximum; 1/2 inch maximum in 40 ft. or more.
4. Variation in sizes and locations of sleeves, floor openings, and wall openings, 1/4 inch.
5. Variations in footings plan dimensions, minus 1/2 inch and plus 2 inches; misplacement or eccentricity, 2 percent of footing width in direction of misplacement but not more than 2 inches; thickness reduction, minus 5 percent.

D. Construct forms tight enough to prevent loss of concrete mortar.
1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct forms for easy removal without hammering or prying against concrete surfaces.
1. Provide crush or wrecking plates where stripping may damage cast concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and like, for easy removal.
4. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
   1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
   2. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete, unless otherwise noted.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in Work.
   1. Determine sizes and locations from trades providing such items.
   2. Obtain written approval of A/E prior to forming openings not indicated on Drawings.

J. Construction and Movement Joints
   1. Construct joints true to line with faces perpendicular to surface plane of concrete.
      a. Where joints divide footings and walls, joints shall have keyway formed. Keyways shall be 1/3 of thickness of element, shall extend to within 3 inches of ends of element and shall be at least 1-1/2 inch thick, unless otherwise noted.
   2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by A/E.
   3. Place joints perpendicular to main reinforcement.
   4. Locate joints for beams, slabs in the middle third of spans.
   5. Locate horizontal joints in walls and columns at underside of floors, slabs, and at the top of footings or floor slabs.

K. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
   1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
   2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

L. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

M. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

N. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

O. Earth Forming: Where footings are to be constructed in cohesive soils, Contractor may elect to earth form footings with approval of A/E. Earth forms shall be excavated to create vertical faces to detailed dimensions within a tolerance of plus 6 inches, minus 0 inch.

3.4 EMBEDDED ITEMS INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
   1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's 303 "Code of Standard Practice for Steel Buildings and Bridges."
   3. Install reglets to receive waterproofing in outer face of concrete frame at exterior walls.
   4. Conduits and pipes of aluminum shall not be embedded in structural concrete unless effectively coated to prevent aluminum-concrete reaction or electrolytic action between aluminum and concrete.

3.5 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place a minimum of 14 days and not until concrete has achieved its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in Work.
   1. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces.
   2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
   1. Align and secure joints to avoid offsets.
   2. Do not use patched forms for exposed concrete surfaces unless approved by A/E.

3.6 VAPOR BARRIER INSTALLATION

A. Vapor Barriers: Place, protect, and repair vapor barriers according to ASTM E 1643 and manufacturer's written instructions.
   1. Place vapor barrier directly below slab and above drainage fill.
      a. Install vapor barrier material with largest dimension parallel with direction of pour.
      b. Face laps away from expected direction of concrete pour whenever possible.
   2. Extend vapor barrier over footings and seal to foundation wall, grade beam, or slab at an elevation consistent with top of slab or terminate at impediments such as waterstops or dowels. Seal around penetrations such as utilities and columns in order to create a monolithic membrane between surface of slab and moisture sources below slab as well as at slab perimeter.
      a. Seal top edge with continuous bead of high-grade mildew resistant silicone sealant or manufacturer’s tape.
   3. Lap joints minimum 6 inches, or as instructed by manufacturer, and seal laps in accordance with manufacturer’s recommendations in a manner consistent with ASTM E1643.
   4. Seal all penetrations (including pipes) with manufacturer’s pipe boot or manufacturer’s instructions.
   5. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged areas 6 inches and sealing all four sides with tape.

3.7 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for placing and supplying reinforcement.
   1. Do not cut or puncture vapor barrier. Repair damage and reseal vapor barrier before placing concrete.
   2. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

B. Accurately position, support, and secure reinforcement against displacement.
   1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
   2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

G. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging.
   1. Support welded-wire reinforcement in accordance with CRSI “Manual of Standard Practice”.
   2. Lap edges and ends of adjoining sheets at least one mesh spacing plus 2 inches for plain wire and 8 inches for deformed wire.
   3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
   4. Lace overlaps with wire.

H. Provide sufficient numbers of supports and of strength to support reinforcement in correct position. Do not place reinforcing bars more than 2 inches beyond last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

I. Reinforcing steel installed in continuous footings shall run continuous. This shall include specially shaped components with proper lap where corner reinforcing and step footings occur.

J. Provide additional reinforcing around required openings in footings and slabs having a one foot least dimension.

K. Support welded wire fabric in slabs-on-ground at 2 feet spacing in both directions.

L. Provide continuous chairs or bolsters to support welded wire fabric in elevated slabs at each line of support for steel deck (e.g., at centerline of supporting joists or beams) and as required to support reinforcing steel in correct position.
   1. It is not acceptable to lift mesh into place during concrete placements

3.8 INSTALLATION OF JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete. Place joints at ends of pours and where placement operations are stopped for more than 1/2 hour, except where such pours terminate at expansion joints.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
   1. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by A/E.
   2. Place joints perpendicular to main reinforcement.
      a. Continue reinforcement across construction joints, unless otherwise indicated.
      b. Do not continue reinforcement through sides of strip placements of floors and slabs.
   3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
   4. Locate joints for beams, slabs, joists, and girders in middle third of spans. Offset joints in girders a minimum distance of twice beam width from a beam-girder intersection.
   5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at top of footings or floor slabs.
   6. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
   7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control (Contraction) Joints in Slabs-on-Grade: Form weakened-plane control (contraction) joints, sectioning concrete into areas as indicated. Construct control (contraction) joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control (contraction) joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control (contraction) joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control (contraction) joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades with a triangular arbor configuration. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random control (contraction) cracks.
    a. For most concrete mixtures, this means sawing should be completed within first six to 18 hours and never delayed more than 24 hours. Early-entry saws are available which may allow cutting to begin within a few hours after placement.
3. Control (contraction) joints shall be filled with self-leveling traffic grade sealant as specified in Division 07 Section “Joint Sealants” for following locations, unless otherwise noted:
    a. Exposed and concealed concrete slabs on grade with no additional floor finish or sealed concrete finish only.
        1) Sealant color shall match sealed concrete color.
4. Locate control (contraction) joints in slabs-on-ground, as indicated, if not shown, then so as to divide slab into sections with a maximum distance of 12 feet between control joints both directions, unless otherwise noted.
5. Contractor may elect to omit all control joints, where slabs are to be covered with a finish material, provided that all cracks that develop at greater than 1/64 inch width be filled with epoxy crack injection adhesive 60 days or more after slab placement.
    a. Exception: Do not omit control joints in slabs scheduled to be exposed.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:
1. Install dowel bars and support assemblies at joints where indicated.
2. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.9 INSTALLATION OF CAST-IN-PLACE CONCRETE

A. General: Comply with ACI SPEC-301.

B. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as work progresses.

C. Notify A/E and testing and inspection agencies 24 hours prior to commencement of concrete placement.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed amount indicated on concrete delivery ticket.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness.
   1. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   2. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   3. Consolidate placed concrete with mechanical vibrating equipment according to ACI SPEC-301.
      a. Do not use vibrators to transport concrete inside forms.
      b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
      c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
      d. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
   4. Concrete shall be completely discharged within 1-1/2 hours after entering conveying drum.
   5. Pumping methods using steel or plastic pipelines will be permitted. Aluminum alloy lines shall not be used. Minimum pipe diameter allowed for pumping shall be 3 inches.
   6. Pumped Concrete: Comply with ACI 304R.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Do not place concrete floors and slabs in a checkerboard sequence.
   2. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   3. Maintain reinforcement in position on chairs during concrete placement.
   4. Screed slab surfaces with a straightedge and strike off to correct elevations.
   5. Level concrete, cut high areas, and fill low areas.
   6. Slope surfaces uniformly to drains where required.
   7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on surface. Do not further disturb slab surfaces before starting finishing operations.
   8. Do not further disturb slab surfaces before starting finishing operations.

3.10 APPLICATION OF FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:
   1. Rough-Formed Finish (SF-1.0): ACI SPEC-301 surface finish as-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
      a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
      b. Remove projections larger than 1 inch.
      c. Tie holes do not require patching.
      d. Surface Tolerance: ACI SPEC-117 Class D.
      e. Apply to concrete surfaces not exposed to public view.
   2. Smooth-Formed Finish (SF-2.0): ACI SPEC-301 surface finish as-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
      a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
      b. Remove projections larger than 1/4 inch.
      c. Patch holes.
      d. Surface Tolerance: ACI 117 Class B.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.11 APPLICATION OF FINISHING FLOOR AND SLABS

A. General Information (Slabs-on-Grade): Requirements indicated are based upon latest FF/FL method. Bids for this work shall reflect these requirements and enforcement can be expected.
   1. Comply with ACI 302.1R recommendations for screeding, re-straightening and finishing operations for concrete surfaces. Do not wet concrete surfaces.
      a. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Finished surface is to be free of trowel marks, uniform in texture and appearance and with surface leveled to tolerances indicated. Do not burnish trowel surface.
      b. Elevated slabs shall comply with following floor flatness (FF) values. Floor levelness values will not apply to elevated slabs.
   2. Finish surfaces to the following tolerances, in accordance with ASTM E 1155.

B. Float Finish (Flt-Fn):
   1. When bleed water sheen has disappeared and concrete has stiffened sufficiently to permit operation of specific float apparatus, consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots.
   2. Repeat float passes and re-straightening, until surface is left with uniform, smooth, granular texture and complies with ACI SPEC-117 tolerances for conventional concrete.
      ~~a.~~ Specified Overall Value: FF 20/FL 15.
   3. Apply float finish to monolithic slab surfaces that are to receive a trowel finish.

C. Trowel Finish; General:
   1. After applying float finish, apply first troweling and consolidate concrete by hard or power-driven trowel.
   2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
   3. Grind smooth any surface defects that would telegraph through applied coatings or floor covering.
   4. Do not add water to concrete surface.
   5. Trowel Finish 1 (Tr-Fn1): Carpeted Floors, unless otherwise noted.
      a. Specified Overall Value: FF 25/FL 20.
      b. Minimum Local Value: FF 17/FL 14.
      c. Apply trowel finish to monolithic slab surfaces that are to receive carpet and noncritical floors where slabs remain exposed, such as mechanical.
   6. Trowel Finish 2 (Tr-Fn2): Floors with improved flatness/levelness requirements.
      a. Specified Overall Value: FF 35/FL 25.
      b. Minimum Local Value: FF 24/FL 17.
      c. Apply trowel finish to monolithic slab surfaces that are to receive thin-set flooring, resilient flooring, linoleum flooring, fluid-applied flooring, resinous flooring and other flooring types, unless otherwise indicated.
         1) At thin-set tile with all edges shorter than 15 inches, maximum allowable variation shall be 1/4 inch in 10 feet from required plane, with no more than 1/16 inch variation in 1 foot when measured from high points of surface. After surface is steel troweled, apply a fine broom finish.
         2) At thin set tile with at least one edge 15 inches in length or longer, maximum allowable variation in substrate is 1/8 inch in 10 feet from required plane, with no more than 1/16 inch variation in 2 feet when measured from high points of surface. After surface is steel troweled, apply a fine broom finish.
         3) At thin-set terrazzo tile floors, maximum permissible variation shall be 1/8-inch in 10 feet from required plane. After surface is steel-troweled, apply a fine broom finish.

7. Trowel Finish 3 (Tr-Fn3): Not Used.
8. Exposed Surfaces: Use steel-reinforced plastic power trowel blades (in lieu of steel) to control dark burnish marks on plain concrete or surface to receive: stain, dye, shake-on, integral pigments, clear sealed.

D. Nonslip Broom Finish (NsBrm-Fn): Apply nonslip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom, perpendicular to main traffic route. Coordinate required final finish with A/E before application.

3.12 MISCELLANEOUS CONCRETE ITEMS INSTALLATION

A. Filling In:
1. Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete base a minimum of 4-inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond maximum dimensions of supported equipment unless otherwise indicated.
3. Minimum Compressive Strength: 4,000 psi at 28 days, unless otherwise indicated.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of concrete base.
5. For supported equipment, install anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.
   a. Use setting drawings, templates, diagrams, instructions and directions finished with items to be embedded.
   b. Cast anchor-bolt insert into bases.
   c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.13 APPLICATION OF CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI SPEC-301 and ACI SPEC-306.1 for cold-weather protection and ACI SPEC-305.1 for hot-weather protection during curing.
2. Maintain moisture loss no more than 0.2 lb./sq.ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Curing Formed Surfaces: Comply with ACI SPEC-308.1 as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer’s instructions.

3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period as follows:
    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
        1) Recoat areas subject to heavy rainfall within three hours after initial application.
        2) Maintain continuity of coating and repair damage during curing period.

D. Curing Unformed Surfaces: Cure concrete according to ACI SPEC-308.1, by one or a combination of following methods:
1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:
    a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of following:
        1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install pre-wetted absorptive cover over entire area of floor.
            a) Lap edges and ends of absorptive cover not less than 12-inches.
            b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
        2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
            a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
            b) Cure for not less than seven days.
        3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, following:
            a) Water.
            b) Continuous water-fog spray.
    b. Floors to Receive Penetrating Liquid Floor Treatments or Sealers: Contractor has option of following:
        1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install pre-wetted absorptive cover over entire area of floor.
            a) Lap edges and ends of absorptive cover not less than 12 inches.
            b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
        2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
            a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
            b) Cure for not less than seven days.
        3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, following:

a) Water.
b) Continuous water-fog spray.

c. Floors to Receive Curing Compound: Do not use where slab will be covered with tile.
1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
a) Apply second coat to all surfaces with a direction of application at 90 degrees to first coat and to same rate of application.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Maintain continuity of coating, and repair damage during curing period.
4) After seven days and curing period has elapsed, remove curing compound as soon as concrete is not subject to rewetting by one of the following methods:
a) Contractor shall “brush blast (shot)” surface. Process involves utilizing a self-contained shot-blasting machine, such as a Blastrac, that utilizes steel shot (170 of 230). By using this process, pores of concrete will open, and floor will be cleaned, but leave a very light profile similar to International Concrete Repair Institute “CSP 1”.
b) Contractor shall employ a mechanical profiling method. Do not acid etch, detergent wash or any method that wets the surface.
c) Curing compounds must be removed after concrete has cured.

d. Floors to Receive Curing and Sealing Compound: Only apply where indicated on Finish Schedule. Do not apply to slabs to receive any other type of coating of finish.
1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.14 TOLERANCES

A. Conform to ACI 117.

3.15 SEALER INSTALLATION

A. Anti-Spalling Sealer: All exterior slabs, unless otherwise noted, shall be sealed with specified penetrating anti-spalling sealer. Surface preparation of slabs and sealer application shall be in strict accordance with directions of manufacturer. Field service shall be provided, upon 5 days’ notice, by manufacturer of sealer to assist contractor in obtaining maximum benefits of product under prevailing jobsite conditions. In addition, sealer representative shall attend pre-installation meeting with A/E and contractor to discuss proper equipment and procedures.

B. Floor Sealing Coat: Apply to all exposed slabs that received curing and sealing compounds before turning over building to Owner.
1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions, including slab preparation requirements.
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2. Application. Apply at a uniform coverage with an individual handheld pump-up or airless sprayer, or by roller. Common garden-type sprayers should not be used. If applying by roller, use a short 3/8-inch nap, solvent resistant roller cover. First coat acts as a primer for second coat. Allow first coat to dry tack-free before applying second coat.
a. Follow manufacturer's prescribed coverage rates.

3.16 INSTALLATION OF JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month.
2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Fill control joints with self-leveling traffic grade sealant at following locations:
1. Exposed slabs with no additional floor finish.
2. Slabs to receive wood floor system.

3.17 INSTALLATION OF CONCRETE SURFACE REPAIRS

A. Defective Concrete:
1. Repair and patch defective areas when approved by A/E.
2. Remove and replace concrete that cannot be repaired and patched to A/E's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins, and other projections on surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by A/E.

D. Repairing Unformed Surfaces:
1. Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface.
   a. Correct low and high areas.
   b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar.
   a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
   a. Treat nonmoving substrate cracks to prevent cracks from telegraphing (reflecting) through underlayment according to manufacturer’s written recommendations.

b. Concrete Substrates: Mechanically remove laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond according to manufacturer's written instructions.

6. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
   a. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to A/E's approval, using epoxy adhesive and patching mortar.
1. Fill all cracks larger than 1/64 inch in both slabs-on-grade and elevated slabs with epoxy crack injection adhesive.

F. Repair materials and installation not specified above may be used, subject to A/E's approval.

3.18 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Batch Tickets (Delivery): Comply with ASTM C94. For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added to Project site.

C. Inspections: Refer to Structural Drawings for list of "Special Inspections".

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 150-cu. yd. or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change and as needed to monitor control of batches.
3. Slump Flow: ASTM C1611
   a. One test at point of delivery for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
   b. Perform additional tests as needed.

4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture. Additional tests as needed to monitor control of batches.
5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 90 deg F and above, and one test for each composite sample.
6. Concrete Density: ASTM C138
    a. One test for each composite sample when strength test specimens are cast.
7. Compression Test Specimens: ASTM C 31.
    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
        1) Strength test results at the designated age shall be the average of two 6 x 12 inch or three 4 x 8-inch specimens.
        2) Transport specimens to lab within 48 hours after casting and cure them in accordance with final curing requirements of ASTM C31 until tested.
8. Compressive Strength Tests: ASTM C39.
    a. Test specimens for compressive strength at 7 days or at an alternative early are as required and one set at 28 days.
    b. Acceptance of concrete shall be based on strength test results of standard cured cylinders in accordance with ASTM C31 and tested at 28 days in accordance with ASTM C39. Strength test results at the designated age shall be the average of two 6 x 12 inch or three 4 x 8-inch specimens.
    c. When strength cylinders are made, test of slump, air content, temperature and density shall be made and recorded with the strength test results.
    d. Strength of each concrete class shall be deemed satisfactory when both of the following criteria are met:
        1) The average of three consecutive compressive-strength tests equal or exceeds specified compressive strength.
        2) Any individual compressive-strength test result does not fall below specified compressive strength, f'c.
            a) By more than 500 psi when f'c $\leq$ 5000 psi.
            b) By more than 0.1 f'c when f'c . 5000 psi.
    e. When compressive strength tests fail to meet the provisions of (d), follow procedure in ACI 301 for evaluation of concrete strength tests.
    f. When it is deemed necessary to evaluate the adequacy of concrete strength, at least 3 cores shall be obtained from the portion of the structure represented by the low strength tests. Cores shall be removed and conditioned in accordance with ASTM C42. The strength of cores shall comply with the following:
        1) Average strength of 3 cores $\geq$ 0.85 f'c.
        2) Individual core strength $\geq$ .75 f'c.
9. Test results shall be reported in writing to A/E, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Rebound hammer, ultrasonic, or other nondestructive device may be permitted by A/E but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by A/E. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by A/E.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in Work that test reports and inspections indicate do not comply with Contract Documents.

E. Contractor shall measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

3.19 CONCRETE WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess concrete materials are Contractor's property. At completion of work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean hardened concrete waste by crushing and mixing with fill material as fill is placed. Comply with requirements of testing agency. Remove reinforcing and segregate to salvaged materials.
   1. Crush concrete waste to less than 1-1/2 inches in each dimension.
   2. Mix crushed concrete waste with at least four parts of specified fill material for each part of concrete waste. Fill material is specified in Division 31 Section "Earth Moving".
   3. Do not dispose of concrete waste as fill within 24 inches of finished grade.

C. Excess Concrete Waste: Remove excess clean concrete waste that cannot be used as fill as described above, and other concreting operations waste, and legally dispose of off Owner's property.
   1. Comply with Division 01 requirement of Section Construction Waste Management and Disposal.

3.20 PROTECTION

A. General, protect concrete surfaces as follows:
   1. Protect from petroleum stains.
   2. Diaper hydraulic equipment used over concrete surfaces.
   3. Prohibit vehicles from interior concrete slabs.
   4. Prohibit use of pipe-cutting machinery over unprotected concrete surfaces.
   5. Prohibit placement of steel items directly on concrete surfaces.
   6. Prohibit use of acids or acidic detergents over concrete surfaces.
   7. Do not drag or drop equipment or material across the slab which will scratch or ship it.
   8. Clean up spills on slab immediately. Provide cleaning chemicals and absorptive materials.

B. Protect concrete that will remain exposed and has or will receive a floor or slab treatment or a curing and sealing compound with protective cover.
   1. Protect "burnished" concrete flooring from foot traffic for a minimum of 4 hours (12 hours is preferable) after application of concrete densifier and chemical hardener.

C. Develop a concrete protection procedure which addresses the following procedures:
   1. Communication of protection plan to subcontractors and vendors.
   2. Procedures for cleaning up slab spills, including use of an availability of cleaning chemicals and absorptive materials at site.

D. Slab Protection: Where concrete surface is scheduled to receive special concrete finish or remain exposed.
   1. Floor must be protected from following:
      a. Silicone chalks should not be used if at all possible. Red and yellow chalks are permanent dyes. Red chalks, black markers, wax pencils should not be used for framing. White or blue chalks are ok. Do not over mark for framing. Do not use silicone sprays to hold lines. Sprays repel stain and leave harsh, permanent scars on floor.
      b. Do not use, tape, glue, solvents, pine-sol, varnish, non-breathing plastics, liquid nail, silicone, plastics, nails, plumbers glue, foam insulation, bond release agents, flux, oils, grease, polyurethane, paint, markers (framers often write dimensions of doorways in marker on slab. They need to make notes on framing instead), grease sticks, spray paints, crayons, muriatic acid, and other chemicals both before and after staining.

2. Do not allow to spill or sit on floor.
   a. It is important that wood, sheet goods, insulation boards, plywood, press board, drywall, sections of framing and like not lay on slab for extended periods of time. They can transfer resins and tannins into slab. This will alter moisture content in slab which leaves a pattern in finished floor. Cardboard should be placed between slab and stacked material to minimize any unwanted transfer. Also food, beverages, oil, glass, metal, paint, chalk, or primers. Be sure to check lifts tires for nails and screws, diaper all equipment from oil and grease drips, don't allow pipe cutting equipment on slab without protection.

END OF SECTION 03 30 00

DIVISION 03 CONCRETE

SECTION 03 06 30.01 - CONCRETE SCHEDULE

SUBMIT THIS SCHEDULE TO CONCRETE SUPPLIER PRIOR TO BIDDING	
ITEM OR STRUCTURE	COMPRESSIVE STRENGTH AND OTHER REQUIREMENTS
Trench footings, footings, and interior foundation and retaining walls	3500 P.S.I. at 28 days Max W/C Ratio = 0.55 Slump Limit: Not less than one inch and not more than 3 inches.
Foundation and retaining walls exposed to exterior	4500 P.S.I. at 28 days Max W/C Ratio = 0.45 Use mid-range water reducer Slump Limit: Not less than one inch and not more than 3 inches. Air Content: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4 inch nominal maximum aggregate size.
Interior formed concrete exposed to view	3500 P.S.I. at 28 days Max W/C Ratio = 0.45
Exposed interior floor slabs and carpeted floors, unless otherwise noted	4000 P.S.I. at 28 days Max W/C Ratio – 0.45 Use mid-range water reducer Slump Limit: 4 inches, plus or minus 1 inch, before adding water-reducing or plasticizing admixtures, with maximum slump less than 6 inches. Do not use high range water reducers. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
Interior floor slabs scheduled to receive thin-set flooring, resilient flooring and other flooring types, unless otherwise noted	4000 P.S.I. at 28 days Max W/C Ratio = 0.45 Use mid-range water reducer Slump Limit: 4 inches, plus or minus 1 inch, before adding water-reducing or plasticizing admixtures, with maximum slump less than 6 inches. Do not use high range water reducers. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent. Use mid-range water reducer
Exterior walks, stoops, steps, aprons, and curbs; exterior formed concrete exposed to view; exterior concrete not otherwise indicated, including but not limited to light pole bases and equipment pads	4500 P.S.I. at 28 days Max W/C Ratio = 0.45 Use mid-range water reducer Air Content: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4 inch nominal maximum aggregate size.
Exterior paving	4500 P.S.I. at 28 days Max W/C Ratio = 0.40 Slump Limit: 5 inches, plus or minus 1 inch. Air Content: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4 inch nominal maximum aggregate size.
Flowable Fill – Type 1 Utility Trench Backfill	50-100 P.S.I. at 28 days Unconfined compression strength per ASTM D4832

Flowable Fill – Type 2 Under Foundations	100 P.S.I. at 28 days Unconfined compression strength per ASTM D4832
Lean concrete fill under footings and encasement of underground utilities or connections	1500 P.S.I. at 28 days Max W/C Ratio = 0.55 for non-air entrained mix

*Refer to Section 03 30 00 – Cast-In-Place Concrete for percent of air entrainment required for concrete mix.

**Refer to Section 03 30 00 – Cast-In-Place Concrete for definitions of finishes.

END OF SECTION 03 06 30.01

DIVISION 04

MASONRY

SECTION 04 20 00.00 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:
   1. Concrete masonry units (CMUs).
   2. Clay face brick.
   3. Mortar and grout.
   4. Reinforcing steel bars.
   5. Masonry joint reinforcement.
   6. Ties and anchors.
   7. Embedded flashing.
   8. Miscellaneous masonry accessories.
   9. Mortar mixes

B. Related Sections include the following:
   1. Division 02 Section “Selection Demolition” for salvaging requirements.
   2. Division 05 Section “Structural Steel Framing” for loose lintels.
   3. Division 07 Section “Sheet Metal Flashing and Trim” for formed reglets and for additional requirements for solder and sealant for sheet metal flashing.
   4. Division 07 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.
   5. Division 07 Section “Preformed Joint Seals” for expansion joints 2 inches wide.
   6. Division 09 Section “Resilient Base and Accessories” for coordination of bullnosed CMU with height of wall base.

C. Products installed, but not furnished, under this Section include the following:
   1. Steel lintels for unit masonry, furnished under Division 05 Section “Structural Steel Framing”.
   2. Products furnished under Division 05 Section “Metal Fabrications”, including post installed anchors.
   3. Nailing blocks furnished under Division 06 Section “Miscellaneous Rough Carpentry”.
   4. Cavity wall insulation furnished under Division 07 Section “Boardstock Air Barrier”.
   5. Hollow metal frames will be provided under Division 08 Section “Hollow Metal Frames”.
   6. Conduits and plumbing will be provided under Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning, Division 26 – Electrical, Division 27 – Communications, and Division 28 – Electronic Safety and Security.

1.2 REFERENCES

A. Definitions
   1. General: Definitions, glossary and terminology used in this Section are from the National Concrete Masonry Association TEK 01-04.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of masonry and masonry accessories with thermal and air barrier and other moisture protection work to provide a tested wall assembly.

B. Coordinate installation of components that are to be embedded in concrete or masonry so as not to interfere with anchors or reinforcement.

C. Furnish setting drawings, templates, and directions for installing anchorages, including concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

D. Pre-installation Meeting: Conduct meeting at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Note: As work progresses, additional pre-installation meetings might need to take place to coordinate installation of various components of exterior enclosure.
   1. Meet with Owner, A/E, mason, and other installers whose work interfaces with or affect masonry.
   2. Review methods and procedures related to masonry installation, including manufacturers' requirements and recommendations.
   3. Review temporary protection requirements.
      a. Walls are to be protected from moisture during construction.
   4. Review mockup and cleaning requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including but not limited to:
   1. Flexible flashing materials, including manufacturer's written installation instructions.
      a. Refer to Division 07 "Air Barrier" sections for flashing requirements. Flashing must be as approved by air barrier system manufacturer for system chosen.
   2. Typical installation methods with requirements to accommodate specific site conditions.

B. Shop Drawings: For the following:
   1. Fabricated Flashing: Detail corner units, end dam units, and other special applications.
   2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI PRC-315, "Guide to Presenting Steel Design Details." Show elevations of reinforced walls.
   3. Fabricated Flashing: Detail corner units, end dam units, and other special applications.
   4. Lintel design types required.

C. Samples for Initial Selection: For the following:
   1. Weep vents.

D. Samples for Verification: For each type and color of the following:
   1. Face brick, in the form of straps of five or more bricks.
   2. Pigmented mortar(s). Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
   3. Accessories embedded in masonry.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
   1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of A/E and approved in writing.

B. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
   1. Masonry units.
      a. Provide material test reports substantiating compliance with requirements, if requested.
      b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
      c. For exposed brick, include material test report for efflorescence according to ASTM C 67, and the following:
         1) Compressive strength
         2) 24-hour cold-water absorption

3) 5-hour boil absorption
4) Saturation coefficient
5) Initial rate of absorption (suction)

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.
9. Flexible Flashing. Certification of compatibility by manufacturer, listing all materials on the Project with which the product and accessories may come into contact, including “air barrier” products.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement. For both fine and course grouts including complete identities and proportions of ingredients.
a. Weight of each ingredient including water.
b. Measured slump.
c. Water/cement ratio.
d. Sieve analysis for aggregates.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated.
1. Cooperate and coordinate with Owner’s Inspection and testing agency. Do not cover any installed flexible flashing membrane, unless it has been inspected, tested, observed and digitally documented by testing lab.

B. Installer
1. Flashing Assemblies: All masonry flashing assemblies shall be installed by masonry craft workers who have completed the International Masonry institute (1-800-IMI-0988) upgrade training course for “Masonry Flashing” or a similar program by flashing manufacturer approved by A/E.
a. Instructor/Flashing Manufacturer’s Representative conducting training for flashing installation shall:
1) Assist/review flashing at “mockup”.
2) Pay at least one other visit to the Project site at the A/E’s direction.
2. At least one supervisory journeyman who shall be present at all times during execution of work, who shall be thoroughly familiar with design requirement, type of materials being installed, reference standards and other requirements, and who shall direct all work performed at jobsite.

C. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
1. Prism Test: For each type of construction as indicated on drawings or described herein, according to ASTM C 1314.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Do not proceed with work prior to receipt of written acceptance of mock-up by A/E. In general, first-in-place masonry items and associated work i.e., openings shall be considered “mockups” and must be reviewed by A/E before similar work advances. Observation and evaluation of the mockup shall be by A/E opening installer, and testing agency.

1. First-in-Place exterior wall(s) in sizes approximately 144 inches long by 120 inches high full and by full thickness, including face and backup wythes and accessories shall serve as a mockup.
    a. General, exterior wall mockup shall be constructed to verify wall performance. Mockup shall demonstrate how components will integrate into the assembly and exhibit how the thermal and air barrier transition to various components, for example, wall transition to roof. Coordinate mockup with testing requirements of Air Barrier.
    b. Use step-back construction to expose the relationship of various wall components to each other. Components incorporated and exposed for observation shall include examples of:
        1) Facing units;
        2) Weeps, vents, cavity drainage material, and other accessories; including clean out ports;
        3) Mortar of the correct color(s) and strength(s);
        4) Backup wall construction;
            a) Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup; with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
        5) Ties and anchors;
        6) Boardstock air/thermal barrier;
        7) Bond beams and lintels;
        8) Flashings (including terminations, plane changes, and end dams);
        9) Masonry expansion joints
        10) Include at least one switch or outlet box. If surface mounted items, such as exterior lighting, audio horns, or video cameras, will be installed in split-faced masonry, provide at least one example installation.
    c. Include a sealant-filled joint at least 16 inches long in each exterior wall mockup.
    d. Mockups shall include typical parapet/eave detail, transitions from wall to roof/roof to wall (flashing, thermal and air barrier transition details), and include the following typical wall penetrations:
        1) Entries/doors.
        2) Openings, i.e. storefront.
            a) First in place of each type opening installed shall leave portions of the perimeter exposed for inspection of fasteners and air barrier transitions. Some portions of mockup shall receive final sealant so it can be tested for air barrier compliance.
            b) Demonstrate blocking at openings, movement joints (sealant filled) minimum 1 to 4 inches.
        3) Include an example of thru-wall penetration by each trade contractor including fire protection, plumbing, mechanical and electrical.
    e. The mockup shall be photographed or recorded on video by the masonry contractor to be part of a presentation for groups of trade’s people as they join project work force.
2. The mockup need not be fully constructed at one time, but construction and approval of each element shall precede the construction of its respective exterior wall components. The mockup shall mirror the building development starting with the foundation and ending at the top of the wall and its transition to the roof. Reviews will be scheduled around the weekly progress meetings. If required attendees are not present, then that phase will be delayed and rescheduled. Respective mockup phase shall be completed and approved before that portion of work starts at the building. Anticipated phasing:

a. Phase One: Install the CMU backup wythe per the approved mockup drawing. The CMU backup wythe shall include rebar, centering clips, ladder reinforcing, grout, bond beam, and bearing plates.
b. Phase Two: Install the embedded flashing in the presence of A/E, flashing manufacturer, and Owner's Testing and Inspection Agency. Embedded flashing shall include the flashing, all sealants and adhesives, termination bar, fasteners, end dams, and inside and outside corners.
    1) Pre-Installation Meeting for masonry veneer will be held on this date.
    2) Flashing will be reviewed and will require approval by all present.
c. Phase Three: Review the exterior face of the CMU backup wythe prior to the installation of the boardstock air barrier. Install the boardstock air barrier in the presence of A/E, Air barrier manufacturer and Inspection Agency.
    1) Pre-Installation Meeting for boardstock air barrier will be held on this date.
    2) Boardstock Air barrier will be reviewed and will require approval by all present.
d. Phase Four: Install the masonry veneer per the approved mockup drawing.
    1) Masonry veneer will be reviewed and will require approval by A/E, and Owner.
e. Phase Five: Clean the mockup veneer.
    1) Pre-Installation Meeting for cleaning of masonry veneer will be held on this date.
    2) Cleaning of mockup veneer will be reviewed and will require approval by A/E, and Owner.

3. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
4. Prior to starting general masonry cleaning, prepare mock-up for cleaning using the same cleaning materials and methods proposed for the Work, and under same weather conditions to be expected during cleaning. Obtain A/E's acceptance of visual qualities before proceeding with masonry restoration. Record cleaning process and results of all testing.
    a. Test materials and methods on samples of adjacent non-masonry materials for possible reaction with cleaning materials, except where materials and methods are known to have a deleterious effect on such materials.
    b. Allow a waiting period of the duration indicated, but not less than 7 calendar days, after completion of sample cleaning to permit a study of sample panels for negative reactions.
5. Protect accepted mockups from the elements with weather-resistant membrane.
6. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship. Panel shall be used as a standard of comparison for all masonry work built of same material.
    a. Approval of mockups is also for other material and construction qualities specifically approved by A/E in writing.
    b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by A/E in writing.
7. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Assume responsibility for acceptance of masonry units delivered to Project site being in compliance with specified ASTM requirements for chippage and dimensional tolerances.
    1. Inspect decorative units upon delivery to ensure color match with required materials and accepted mock-up panel.

B. Store masonry units on elevated platforms in a dry location to prevent contamination by mud, dust or materials likely to cause staining or other defects. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
   1. Cover masonry units at all times.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
   1. Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands.
   2. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness.

D. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.
   1. Stockpile and handle aggregates to prevent contamination from foreign materials. Store different aggregates separately.
   2. Store sand on tarps to keep ground water from wicking into sand.

E. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
   1. Deliver flexible flashing materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
   2. Store flexible flashing materials as recommended by manufacturer. Keep away from open flame or sources of ignition.

G. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
   1. Separate and recycle waste materials in accordance with the Waste Management Plan and to the maximum extent economically feasible.
      a. Fold up metal banding; flatten and place in designated area for recycling.
      b. Collect wood packing shims and pallets, place in designated area.
   2. Recycling: Undamaged, excess masonry materials are Contractor's property and shall be removed from the Project site for his use.
   3. Disposal as Fill Material: Dispose of clean masonry waste, including broken masonry units, waste mortar, and excess or soil contaminated sand, by crushing and mixing with fill material as fill is placed.
      a. Crush masonry waste to less than 2 inches in greatest dimension.
      b. Mix masonry waste with at least 2 parts specified fill material for each part masonry waste. Fill material is specified in Division 31 Section "Earth Moving".
      c. Do not dispose of masonry waste as fill within 18 inches of finished grade.
   4. Excess Masonry Waste: Remove excess, clean masonry waste that cannot be used as fill, as described above and other masonry waste, and legally dispose of off Owner's property.

1.8 FIELD CONDITIONS

A. Refer to Division 01 Section "Product Requirements".
   1. Do not apply flexible flashing on wet or damp surfaces.
   2. Apply flashing to surfaces free of dirt, oils, lubricants, and other debris.
   3. Install flexible flashing materials at temperature above 40 deg. F. At temperature below 40 deg. F., apply primer in accordance with flashing manufacturer's recommendations, prior to installation of flashing.

4. Do not use metal reinforcements or ties coated with loose rust or other coatings, including ice, which will reduce bond.

B. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Temporary measures include application of self-adhered membrane or flashing with long UV exposure. Cover partially completed masonry when construction is not in progress. Refer to Section 1.8B ("Masonry Protection") in TMS 402/602. Note: Protection is required by Building Code.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
   2. Continue to cover walls until tie-in to roof is complete and top of wall is protected from water penetration.

C. This structure is designed to be self-supporting and stable after the building is fully completed. Protect masonry walls against wind damage by bracing as required until support of walls is integral with the completed building structure. This includes the addition of whatever temporary bracing, guys, or tie-downs that might be necessary. Such material is not shown on the Drawings. If applied, they shall be removed as conditions permit and shall remain the Contractor's property.
   1. Safety: It is solely the Contractor's responsibility to follow all applicable safety codes and regulations governing this Work.
   2. Load application after building masonry columns, piers, or walls
      a. Do not apply uniform design floor or roof loading for at least 12 hours.
      b. Do not apply concentrated loads for at least 3 days.

D. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

E. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with NCMA TEK 03-01C. Comply with cold-weather construction requirements contained in TMS 402/602 with special emphasis on the following:
   1. Preparation
      a. If snow or ice has formed on masonry bed, remove if by carefully applying heat not to exceed 120 degrees F until the surface is dry to the touch.
      b. Remove any mortar that is frozen or damaged.
   2. Work in Progress
      a. Air temperature 40 degrees F to 32 degrees F.
         1) Heat sand or mixing water to produce mortar temperatures that match air temperatures.
         2) Maintain temperature of mortar on boards above freezing.
         3) Installation in colder air temperatures will require heat sources on the wall and use of windbreaks or tents to create a controlled environment suitable for proper bonding and curing.
   3. Completed Work and Work not in Progress:
      a. Main daily air temperature at 40 degrees F: Protect masonry from rain and snow for 24 hours by covering with a weather-resistive membrane.
      b. Mean daily temperature of 32 degrees F to 25 degrees F: Cover masonry with a weather-resistive membrane for 24 hours.
      c. Mean daily air temperature of 25 degrees F to 20 degrees F: Cover masonry with insulating blankets for 24 hours.

4. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
    a. To assure mortar temperatures between 40 degrees F and 120 degrees F until used, heat mixing water or aggregates when air temperature is between 32 degrees F and 40 degrees F. When the air temperature is between 25 degrees F and 32 degrees F, heat both water and aggregate.
    b. Do not heat water or sand above 160 degrees F.
5. Comply with the requirements of the governing code and with the "Construction and Protection Recommendations for Cold Weather Masonry Construction" of the Technical Notes of Brick and Tile Construction by the Brick Industry Association (BIA) and International Masonry Industry All-Weather Council, “Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.”

F. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602 and the following:
1. Masonry construction performed when ambient temperature exceeds 100 degrees F (or 90 degrees F with wind velocities greater than 8 mph) shall conform to the following requirements:
    a. Store materials in cool, shaded location.
    b. Cover aggregate stockpiles with black plastic sheet to retard the evaporation of moisture.
    c. Cool reinforcing steel, metal accessories, wheelbarrows, mixers and mortar boards by flushing with water.
    d. Wet high-suction brick.
    e. Increase lime and/or cement content to maximum allowed under ASTM C270 for mortar type specified.
    f. Increase water content of mortar and grout as needed.
    g. Spread mortar beds no more than 4 feet ahead of masonry and set units within one minute of spreading mortar.
    h. Moist cure masonry by water fog spray after tooled joints have set.
    i. Cover walls to retard evaporation.
    j. Schedule work to avoid hottest part of day.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany request for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate. Do not change source or brands of masonry mortar materials during the course of the Work.

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified:
   1. TMS 402/602 "Building Code Requirements and Specification for Masonry Structures."
      a. Maintain one copy of the standard in project field office at all times during construction. Contractor's supervisory personnel shall be thoroughly familiar with this material as it applies to the project and shall be present at all times and direct work performed under this Section.
   2. National Concrete Masonry Association (NCMA)
      a. NCMA TEK Bulletin 03-08A "Concrete Masonry Construction".
      b. NCMA TEK Bulletin 09-01A "Mortars for Concrete Masonry."
   3. Brick Industry Association (BIA)
      a. BIA Technical Notes No. 1 – Revised 1992: All weather construction.
      b. BIA M1-88: Specifications for Portland Cement Lime Mortar for Brick Masonry.
      c. BIA Technical Notes No. 7 – Water Penetration Resistance – Design and Detail.
      d. BIA Technical Notes No. 18A – Accommodating Expansion of Brickwork.
      e. BIA Technical Notes No. 27 – Revised 1994: Brick Masonry Rain Screen Walls.
      f. BIA Technical Notes No. 20 – Revised 1990: Cleaning Brick Masonry.
      g. BIA Technical Notes No. 28B – Revised 1987: Brick Veneer.

B. Corrosion and Staining Control: Prevent galvanic or other forms of corrosion as well as staining by isolation metals and other materials from direct contact with incompatible materials. Materials shall not stain exposed surfaces of veneer and joint materials.

2.3 MASONRY UNITS, GENERAL

A. Masonry Standard: Comply with ACI/ASCE 6/TMS 602, unless modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry and will be within 20 feet vertically and horizontally of walking surface.

2.4 CONCRETE MASONRY UNITS (CMUs)

A. Shapes: Provide shapes indicated and as follows:
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide bullnose units for outside corners and at sills, unless otherwise indicated or sill is indicated to receive additional finish materials.
      a. At base of wall and where indicated (first CMU course above floor), provide exposed square edge external corners. Above base transition square edge to the bullnose above by grinding.
      b. Provide bullnose unit with 1 inch radius bullnose (BN1), unless otherwise noted.

B. Concrete Masonry Units: ASTM C 90.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2600 psi. Design compressive strength of masonry system (f'm) is to be no less than 2250 psi with Type M or S mortar.
   2. Weight Classification: Normal weight.

3. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

2.5 MASONRY LINTELS

A. Concrete Lintels: Not acceptable.

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from specially formed “U” shaped lintel units with reinforcing bars placed as indicated and filled with coarse grout. Open-bottom, bond-beam type units are not acceptable for use as reinforced lintels. Cure prefabricated lintels before handling and installing. Temporarily support built-in-place lintels until cured. Prefabricated lintels shall have a faux head joint pattern on their exposed faces and shall have their top side clearly marked in the factory. Prefabricated lintels are to be installed such that the faux head joint pattern aligns with that of the surrounding masonry.
1. Knockout blocks will be not acceptable.

2.6 BRICK

A. General: Provide shapes indicated and as follows:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick: ASTM C 216, Grade SW, Type FBS.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi.
2. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
3. Modular: Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long, unless otherwise noted or required to match existing.
4. Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.
    a. Type “1” Black Bricks: Ebony Black Smooth; Belden Brick.
        1) Texture: Smooth
    b. Type “2” Olde Cheyene; Bowerston
        1) Texture: Sanded

2.7 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color(s) indicated.
1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of Portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 270, Type S.

D. Masonry Cement: ASTM C 91, low in alkali.
1. Products:
    a. Brixment or Velvet; Essroc, Italcementi Group.

b. Mortamix Masonry Cement or Rainbow Mortamix Custom Buff Masonry Cement or White Mortamix Masonry Cement; Holcim (US) Inc.
c. Magnolia Masonry Cement or Lafarge Masonry Cement or Trinity White Masonry Type S or Trinity White Masonry Type N; Lafarge North America Inc.
d. Lehigh Masonry Cement or Lehigh White Masonry Cement; Lehigh Cement Company.
e. Richmortar; CEMEX.
f. Miami Masonry Cement; Fairborn Cement Company.

E. Mortar Cement: ASTM C 1329.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Products:
a. Bayferrox Iron Oxide Pigments; Bayer Corporation, Industrial Chemicals Div.
b. True Tone Mortar Colors; Davis Colors.
c. MasterColor; Master Builders Solutions.
d. SGS Mortar Colors; Solomon Grind-Chem Services, Inc.
e. Prism Pigments, a Division of Mix Manufacturing, Inc.
f. Euclid Chemical Company.
g. Lanxess Corp.
h. Acme-Hardesty Co., Acme-Shield Plus Admixture; Cargill.

G. Colored Cement Product: Packaged blend made from Portland cement and lime, masonry cement, or mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Products:
a. Colored Portland Cement-Lime Mix:
1) Rainbow Mortamix Custom Color Cement/Lime; Holcim (US) Inc.
2) Eaglebond; Lafarge North America Inc.
3) Lehigh Custom Color Portland/Lime Cement; Lehigh Cement Company.
4) Color Mortar Blend; Glen-Gery Corp.
5) Salyor’s PLUS; Essroc.
6) PCL; CEMEX.
b. Colored Masonry Cement:
1) Flamingo-Brixment; Essroc, Italcementi Group.
2) Rainbow Mortamix Custom Color Masonry Cement; Holcim (US) Inc.
3) Magnolia Masonry Cement; Lafarge North America Inc.
4) Lehigh Custom Color Masonry Cement; Lehigh Cement Company.
5) Coosa Masonry Cement; National Cement Company, Inc.
6) Richcolor Masonry Cement; CEMEX.
7) Miamicolor Masonry Cement; Fairborn Cement Company.
2. Formulate blend as required to produce color(s) indicated or, if not indicated, as selected from manufacturer's standard colors.
3. Pigments shall not exceed 10 percent of Portland cement by weight.
4. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.

H. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

I. Aggregate for Grout: ASTM C 404.
1. Fine Aggregates: ASTM C404, clean, sharp, natural sand free from loam, clay lumps, or other deleterious substances.
2. Coarse Aggregates: ASTM C404, clean, uncoated, pea gravel containing no clay, mud, loam, or foreign matter. Maximum aggregate size 3/4 inch.

J. Admixtures, General:
   1. No air-entraining admixtures or material containing air-entraining admixtures.
   2. No antifreeze compounds shall be added to mortar.
   3. No admixtures containing chlorides shall be added to mortar, especially calcium chloride is not permitted.

K. Water: Conform to ASTM C1602 for mixing water. At water shall be clean and free from organic material and delirious amounts of dissolved acids, alkalis and salts.

2.8 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60 (Grade 420).
   1. Size, length, and spacing shall be as indicated.
   2. Where No. 3 and larger are indicated, they shall be deformed steel, conforming to ASTM A615, Grade 60.
   3. Use #4 spacer bars at 48 inch spacing connected to longitudinal reinforcing bars in concrete masonry bond beams to hold bars in proper location.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
   1. Products:
      a. No. 376, 377, 378, or 379 Rebar Positioner; Heckmann Building Products Inc.
      b. #RB or #RB-Twin Rebar Positioner; Hohmann & Barnard, Inc.
      c. Figure-8, Double Figure-8, O-Ring or Double O-Ring Rebar Positioner; Wire-Bond.

C. Masonry Joint Reinforcement, General: ASTM A 951 and as follows:
   1. Provide welded wire units prefabricated in straight lengths of not less than 10 foot, with matching corner ("L") and intersection ("T") units.
   2. Fabricate from cold-drawn steel wire complying with ASTM A82, with deformed or embossed continuous side rods and plain cross-rods, with unit width of 1-1/2 to 2 inches less than thickness of wall or partition.
   3. Wire shall be galvanized in accordance with the following:
      a. Joint reinforcement, interior walls or exposed to relative humidity less than or equal to 75 percent.
         1) ASTM A641, mill galvanized (0.10 oz. per sq.ft.)
      b. Wire ties or anchors in interior walls or exposed to relative humidity less than or equal to 75 percent
         1) ASTM A641 (0.35 oz. per sq.ft.)
      c. Joint reinforcement, wire ties, or anchors in exterior walls or a mean relative humidity exceeding 75 percent
         1) ASTM A153, Class B (1.50 oz. per sq.ft.)
      d. Sheet metal ties or anchors, interior walls or exposed to relative humidity less than or equal to 75 percent
         1) ASTM A653, G60 (0.60 oz. per sq.ft.)
      e. Sheet metal ties or anchors in exterior walls or a mean relative humidity exceeding 75 percent
         1) ASTM A153, Class B (1.50 oz. per sq.ft.)
      f. Steel plates and bars
         1) ASTM A153, Class B
   4. For single wythe interior CMU walls, provide ladder type joint reinforcing fabricated with two W1.7 or 0.148 inch steel side rods and W1.7 or 0.148 inch cross rods. Joint reinforcing shall be placed in every other CMU joint or not more than 16 inches o.c.
   5. Multi-wythe exterior walls consisting of CMU backup, insulated cavity, and exterior face brick veneer.
      a. When both wythes are to be constructed simultaneously:

1) Provide ladder type joint reinforcing fabricated with three W1.7- or 0.148-inch steel side rods and W1.7- or 0.148-inch cross rods. Joint reinforcing shall be placed in every other CMU joint or not more than 16 inches o.c.

b. When each wythe is to be constructed separately:

1) Backup Wythe

a) Provide adjustable ladder type joint reinforcing fabricated with two W1.7- or 0.148-inch steel side rods, W1.7- or 0.148-inch cross rods, 3/16-inch eyes and 3/16 inch double legged pintles. Longitudinal rods shall be spaced for each face shell of CMU; eye sections shall extend into wall's cavity, and pintles shall rest upon bed joints of veneer. Joint reinforcing shall be placed in every other CMU joint or not more than 16 inches o.c.

6. For foundation walls consisting of two wythes of CMU, provide ladder type joint reinforcing fabricated with four W1.7 or 0.148 inch steel side rods and W1.7 or 0.148 inch cross rods. Joint reinforcing shall be placed in every CMU joint or no more than 8 inches o.c. Side rods shall align with face shells of CMU.
7. For single wythe foundation walls, provide ladder type joint reinforcing fabricated with two W1.7 or 0.148 inch steel side rods and W1.7 or 0.148 inch cross rods. Joint reinforcing shall be placed in every CMU joint or no more than 8 inches o.c.
8. For joint reinforcing in walls, other than those described above, refer to Drawings for particular requirements.
9. All ladder type joint reinforcing shall have cross rods spaced at 16 inches o.c.
10. All ladder type joint reinforcing shall be lapped 6 inches minimum.
11. All ladder type joint reinforcing shall be discontinuous across movement joints.

2.9 TIES AND ANCHORS

A. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

1. Ensure components and materials are compatible with specified accessories and adjacent materials.

B. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with subparagraphs below, unless otherwise indicated.

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 1064; with ASTM A 641, Class 1 coating, provide in interior walls where humidity is less than 75 percent.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 1064; with ASTM A 153, Class B-2 coating, unless otherwise noted.
3. Galvanized Steel Sheet: ASTM A 653, Commercial Steel, G60 (Z180) zinc coating, provide in interior walls where humidity is less than 75 percent.
4. Steel Sheet, Galvanized after Fabrication: ASTM A 1008, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153, unless otherwise noted.
5. Steel Plates, Shapes, and Bars: ASTM A 36.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls, unless otherwise indicated.
2. Tie Section for Steel Frame: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.188-inch diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls, unless otherwise indicated.

D. Adjustable Masonry-Veneer Anchors: Provide either screw-attached, masonry-veneer anchors with separate horizontal reinforcing or seismic masonry-veneer anchors.

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over boardstock air barrier to metal studs, and as follows:
    a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch.
    b. Anchor shall meet or exceed requirements for air leakage and water penetration established for Project.
2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
    a. Fabricate sheet metal anchor sections and other sheet metal parts from 0.067-inch thick, steel sheet, galvanized after fabrication.
    b. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.188-inch diameter, hot-dip galvanized steel wire.
    c. Products:
        1) 315-D with 316 or Pos-I-Tie or 213-2X; Heckmann Building Products Inc.
        2) HB-213 with 2X Hook or Adjusto-Tie; Hohmann & Barnard, Inc.
        3) 1004, Type III or RJ-711; Wire-Bond.
        4) Thermal-Grip Masonry Veneer Anchor Pos-i-tie: TRUFAST Walls.
        5) H-13 Anchor with Hook 3GEN Masonry Products, Inc.
3. Anchor Section: Corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed, washer head or tape to protect hole in sheathing.
    a. Products
        1) Pos-I-Tie; Heckmann Building Products.
        2) SureTie; Wire Bond.
        3) X-Seal Anchor or 2 Seal Tie Veneer Anchor; Hohmann and Barnard.
        4) Thermal Grip MVA or Pos-i-tie: TRUFAST Walls.
        5) Barrel Anchor 3GEN Masonry Products, Inc.
4. Drill Screws: Provide either of the following types:
    a. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange with not less than 3 exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.
        1) Products:
            a) Teks Maxiseal with Climaseal finish; ITW Buildex.
            b) Elco Dril-Flex with Saltgard finish; Textron Inc., Textron Fastening Systems.
            c) 4000 with Climaseal finish; Wire-Bond.
    b. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads.
        1) Products:
            a) Scots long life Teks; ITW Buildex.
            b) Teks Maxiseal with Climaseal finish; ITW Buildex.
            c) Elco Dril-Flex with Saltgard finish; Textron Inc., Textron Fastening Systems.
            d) SFS Stadler SX Fastener; Wire-Bond.
            e) SDS Style; TRUFAST Inc.

2.10 MISCELLANEOUS ANCHORS

A. Stabilization Anchors: Provide where masonry walls intersect concrete or existing masonry walls. Bonds masonry walls and restrains lateral movement while allowing expansion and control joints to perform as designed.
    1. Products:

a. Slip Set Stabilizer; Hohmann & Barnard, Inc.
b. 1700; Wire-Bond.

B. Interior masonry walls supported on slabs intersect masonry walls, provide hot dip galvanized 1/2 inch by 16-gauge mesh ties spanning horizontally.
1. Products:
a. #MWT Mesh Wall Tie; Hohmann & Barnard, Inc.
b. Wire Mesh 269; Heckman Building Products.
c. Wire Mesh Tie; Wirebond.
d. Mesh Tie; MasonPro.

2.11 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
1. Reglets/Receivers: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with mitered and welded corners and junctions. Formed reglets must comply with requirements of Division 07 Section “Sheet Metal Flashing and Trim”.
a. Materials, provide one of the following:
1) Stainless Steel: 0.0187 inch thick (fka 26 gauge).
b. Masonry Type: Provide extension leg to extend to face of inner CMU wythe (or sheathing with a veneer wall configuration) with an off-set top flange.
2. Metal Terminations for Flexible Flashing: Fabricate from 26 or 28 gauge stainless steel. Extend into wall as indicated (but not less than 3 inches) and out to exterior face of wall. At exterior face of wall, bend metal down at an angle and back on itself for 3/4 inch to form a drip edge.
a. Provide a bead of elastomeric silicone sealant between lintel and drip edge to prevent water from wicking back onto lintel.
b. Provide hemmed edge turning back 180 degrees to be flush with face of veneer at base of wall only.
3. Stainless steel end dams may also be used in conjunction with flexible flashing.

B. Flexible Flashing: For flashing not exposed to the exterior, coordinate with air barrier system and use the following, unless otherwise indicated:
1. Provide one of the following:
a. York 304 SA Self-Adhered, Stainless Steel; York Manufacturing, Inc.
b. Gorilla Flash SS Peel and Stick Butyl; STS Coatings, Inc.
c. IPCO Self-Adhesive Stainless Steel; Illinois Products, Inc.
d. TK Self-Adhering Stainless Steel TWF; TK Products, Inc.
e. Mighty-Flash-SA; Hohmann and Barnard Inc.
f. Bond-N-Flash S.A.; Wire Bond
g. GENFLASH SA 304 Self-Adhered Stainless Steel; 3GEN Masonry Products, Inc.
2. Characteristics/Properties
a. Type: Stainless steel core with one stainless steel face with a butyl block co-polymer adhesive.
b. Stainless steel type: 304, ASTM A 167.
c. Adhesive: Block co-polymer.
d. Size: Manufacturer’s standard width rolls.
e. Performance attributes
1) Tensile strength, > 90,000 psi
2) Puncture resistance, > 2,500 pounds average
3) When tested as manufactured, product resists growth of mold pursuant to test method ASTM D 3273.
3. Accessories: Products shall be as recommended by flashing manufacturer
a. Polyether Sealant
1) UniverSeal US-100; York Manufacturing, Inc.
2) GreatSeal LT-100; STS Coatings, Inc.
3) R-Guard Joint Seam Sealer; Prosoco, Inc.

4) HB Sealant; Hohmann and Barnard Inc.
5) Quick Set Sealant; Wire Bond

b. Splice Tape/Transition Flashing (Self Adhered)
1) York 304SS; York Manufacturing, Inc.
2) IPCO Self-Adhering Stainless Steel Flashing; Illinois Products, Inc.
3) X-Seal Splice Tape; Hohmann and Barnard Inc.
4) Anchorseal Tape: Wire Bond

c. Corner and End Dams: Use only 26-gauge stainless steel pre-manufactured corners.

d. Water-Based Primer: Provide when recommended by manufacturer for application indicated.
1) Primer-SA; Hohmann and Barnard Inc.
2) Aqua Flash Primer; Wire Bond

C. Adhesives, Mastic, Sealant, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

D. Termination Bar: 26 gauge, minimum predrilled stainless-steel approximately 1-1/2 inch wide by 8-foot sections, 45 deg. lip at top for sealant, to be used at top of flashing to secure it to backup.
1. Acceptable Manufacturers/Products
a. T-2 Termination Bar; Hohmann & Barnard, Inc.
b. #4210 Termination Bar; Wire-Bond.
c. Stainless Steel Accessories 45; York Flashings.
d. Stainless Steel Termination Bar; IPCO.
e. Type L Stainless Steel Termination Bar; 3GEN Masonry Products, Inc.

2.12 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or urethane.
1. Products:
a. Neo-Seal IV 2218-3/Everlastic 1056 Joint Filler; Williams Products, Inc.
b. #NS-Closed Cell Neoprene Sponge; Hohmann and Barnard, Inc.
c. Neocell; IPCO.
d. #NS-Closed Cell; National Construction Materials Corp.
e. Sandell's Closed Cell Neoprene; Sandell Construction Solutions.

B. Thermal Barrier (Break); Unfaced, Mineral-Wool Board Insulation: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Nominal density of 4.4 lb./cu.ft.
2. Moisture Resistance; ASTM C 1104: Moisture Sorption, 0.03 percent.
3. Thermal Resistance; ASTM C 518: R-value/inch at 75 deg. F., 4.2 hr.ft.^{2}. F/Btu.

C. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

D. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

E. Weep/Vent Products: Use one of the following, unless otherwise indicated:
1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color(s) selected from manufacturer's standard.

a. Products:
1) Mortar Maze weep vent; Advanced Building Products Inc.
2) No. 85 Cell Vent; Heckmann Building Products Inc.
3) Quadro-Vent; Hohmann & Barnard, Inc.
4) Cell Vent, 3601; Wire-Bond.
5) Sandell's Cell Vents; Sandell Construction Solutions.
6) Cell Vent; MasonPro.
7) Cell Vent; Mortar Net Solutions.
8) Mortar Maze weep vent; Advanced Building Products, Inc.

2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color(s) selected from manufacturer's standard.
3. Adjustable Weep Vent: IPCO.
4. Stainless Steel Weep/Vent: Type 304 stainless steel.
a. York Manufacturing Inc.

F. Cavity Mortar Protection Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity. Installer shall select product thickness(es) in the field based on observed clear air space between cavity insulation and outer wythe. Clear air space shall not exceed selected product thickness by more than 0.40-inch. Where clear air space exceeds manufacturer's thickest available product by more than 0.40-inch, Installer shall insert a supplemental wythe of extruded polystyrene (XEPS) insulation on inner face, sized to make up the difference.
1. Provide one of the following types:
a. Profiled strips, 10-inches high, with dovetail shaped notches 7-inches deep that prevent mesh from being clogged with mortar droppings.
b. Rectangular strips, not less than 10-inches high, with or without dimpled surface, designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
c. Sheets or rectangular strips installed continuously from flashing to height indicated, to prevent weep holes from being clogged with mortar.
2. Products:
a. Mortar Break; Advanced Building Products Inc.
b. CavClear Masonry Mat; Archovations, Inc.
c. Mortar Web/Trap; Hohmann & Barnard Inc.
d. Mortar Mitt; Sandell.
e. Driwal Mortar Deflection/Driwall Masonry Vent System; Keene Building Products.
f. Mason ProNet DT; MasonPro.
g. Mortar Net; Mortar Net Solutions.
h. Weep-Net; York Manufacturing Inc.
3. Fabric Mesh to Prevent Clogging of Weep Holes (Option): Non-woven polyester fabric used as part of masonry cavity drainage systems with flashing, weep holes or weep vents. Drapes over interior side of weep holes/vents keeping them free of mortar and debris; routes water to flashing and to weeps by draining through body of product.
a. Materials: Recycled polyester, free-draining mesh, made from polymer stands that will not degrade within cavity wall.
b. Mold Growth Resistance: In compliance with ASTM D 3273 and ASTM G 21.

G. Grout Sample Box: When approved by the A/E, grout sample box shall be proven by tests to yield comparable compressive strength values to samples cast by traditional methods regardless of CMU moisture content. Box shall perform as a mold and transport/shipping container in one as specified by ASTM C 1019.
1. Basis-of-Design: Deslauriers, Inc.

H. Column Isolation: Around all columns in masonry walls, provide 1/2-inch minimum isolation material to prevent the masonry from coming in contact with the displaced column during loading and to prevent mortar from being within the same joint.
1. Products:
a. Ceramar Flexible Foam; W.R. Meadows, Inc.

b. Econ-O-Foam; Williams Products.
c. Nomaboard; Nomaco Inc.
d. Column Backboard; Williams Products.
e. Column Wrap; MasonPro.

I. Grout Stop: Fiberglass, galvanized steel, or polypropylene screen.
1. Products:
a. Metal Lath 268; Heckmann Building Products, Inc.
b. MGS - Mortar/Grout Screen; Hohmann & Barnard, Inc.
c. Grout Stop 3612; Wire-Bond.
d. Grout Stop; MasonPro.

J. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 degrees F (minus 32 degrees C). Provide products with low compression set and of size and shape to provide a seal for compartmentalization.

2.13 CAVITY WALL INSULATION

A. Refer to Division 07 Section “Boardstock Air Barrier”.

2.14 MASONRY CLEANERS AND ACCESSORIES

A. Preformed Expansion Joint Filler: Provide closed cell sponge neoprene expansion joint filler conforming to ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated.

B. Bituminous Coating: Cold applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D1187, Type II.

C. Masonry Cleaners: Provide one of the following cleaning products expressly approved for intended use by cleaner manufacturer and manufacturer of unit being cleaned as verified on “mock-up”.
1. Job Mixed Detergent Solution: Solution of trisodium phosphate (1/2 cup dry measure) and laundry detergent (1/2 cup dry measure) dissolved in one gallon of water.
2. Proprietary Acidic Cleaner: Manufacturer's standard strength, general purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from masonry surfaces of type indicated below without discoloring or damaging masonry surfaces; expressly approved for intended use by manufacturer of masonry units being cleaned. Do not use products containing hydrochloric (muriatic acid, hydrofluoric acid, or ammonium bifluoride.
a. For brick masonry not subject to metallic oxidation stains, use formulation consisting of a concentrated blend of surface acting acids, chelating, and wetting agents.
1) Products:
a) Sure Klean No. 600 Detergent; ProSoCo., Inc.
b) 202 Detergent; Diedrich Technologies.
c) NMD 80 New Masonry Detergent; EaCo Chem, Inc.
b. For dark colored brick masonry not subject to metallic oxidation stains, use formulation consisting of a liquid blend of surface acting acids and special inhibitors.
1) Products:
a) ProSoCo., Inc.; Sure Klean No. 101 Lime Solvent.
b) Diedrich Technologies; 200 Lime Solv.
c) EaCo Chem, Inc., NMD 80 New Masonry Detergent.
c. For brick masonry subject to metallic oxidation stains, use formulation consisting of a liquid blend of organic acids and special inhibitors.
1) Products:

a) Sure Klean Vana Trol; ProSoCo., Inc.
b) 202 Vana-Stop; Diedrich Technologies.
c) NMD 80 New Masonry Detergent; EaCo Chem, Inc.

D. Spray Equipment: Provide equipment for controlled spray application of water and chemical cleaners, if any, at rates indicated or recommended for pressure, measured at spray tip, and for volume. Adjust pressure and volume, as required, to ensure that damage to masonry does not result from cleaning methods.
1. For chemical cleaner spray application, provide a low pressure tank or chemical pump suitable for the chemical cleaner indicated, equipped with a cone-shaped spray tip.
2. For water spray application, provide a fan-shaped spray tip that disperses water at an angle of not less than 15 degrees.

2.15 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. When specifically approved by the A/E, admixtures shall meet ASTM C1384 Standard Specification for Admixtures for Masonry Mortars.
1. Do not use calcium chloride in mortar or grout.
2. Maintain workability of standard grey mortar by remixing or retempering. No mortar shall be used beyond 2-1/2 hours after mixing. Do not retemper colored pigmented mortar because color variations may result.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar Batching
1. For each unit volume of cementitious materials, provide 2.25 to 3.5 volumes of aggregates.
2. In a running mechanical paddle mixer, add 2/3 of the water and 1/2 of the aggregate (sand), then add the cementitious materials. Follow by adding the remaining water. Mix for a minimum of 5 minutes, adding water if required to produce a workable consistency.
a. Do not hand mix mortar, unless approved in writing by A/E.

C. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions and thoroughly blend ingredients before delivering to Project site.

D. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For non-load bearing interior partitions (infill), use Type N or S, unless otherwise noted.
2. For exterior, above-grade, masonry veneer, use Type N or S, unless otherwise noted.
a. Provide Type S for clay masonry when initial rate of absorption is less than 10 g/min/30 in^2.

E. Use natural (noncolored) mortar for the following:
1. Concrete masonry units, unless otherwise noted.

F. Colored Pigmented Mortar: Select and proportion pigments with other ingredients to produce color indicated or, if not indicated, as selected from manufacturer's standard formulation to compliment adjacent units.
1. Use colored pigmented mortar for the following locations:
a. Clay face brick, as indicated or required to match existing.
2. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color(s) required. Limit pigments to the following percentages of cement content by weight:
a. For mineral oxide pigments and Portland cement lime mortar, not more than 10 percent.

b. For carbon black pigment and Portland cement lime mortar, not more than 2 percent.
c. For mineral oxide pigments and masonry cement mortar not more than 5 percent.
d. For carbon black pigment and masonry cement mortar, not more than 1 percent.

3. Color: Match existing as approved in samples and mockup.

G. Grout for Unit Masonry (by Strength): Comply with ASTM C 476. Grout mixes shall be designed by strength, unless specifically noted otherwise in the Contract Documents.

1. Conventional Grout
   a. General: Do not use admixtures, including pigment, air-entraining agents, accelerators, retarders, water repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. Do not lower the freezing point of grout by use of admixtures or anti-freeze agents.
      1) Admixtures containing chlorides in excess of 0.2 percent chloride ions are not permitted to be used.
      2) Antifreezes are prohibited for use in grouts.
      3) Flyash: ASTM C618-89a, Type C or F may be substituted for up to 20 percent of the total cementitious materials in the gout mix.
   b. Grout mixes shall be plant mix or factory blended (dry mix with water added at Project site).
   c. Field mixed grout designs are not acceptable.
   d. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in TMS 402/602 for dimensions of grout spaces and pour height.
   e. Provide grout with a slump of 8 to 10 inches as measured according to ASTM C 143.
2. Self-Consolidating Grout
   a. Jobsite proportioning of self-consolidating grout is not permitted. Do not add water at jobsite except in accordance with self-consolidating grout manufacturer's instructions.
   b. Admixtures for Self-Consolidating Grout
      1) High-Range Water-Reducing Admixture
      2) Viscosity-Modifying Admixture
   c. Slump Flow: 24 to 30 inches as determined in accordance with ASTM C1611.
   d. Visual Stability Index (VSI): Less than or equal to 1 as determined in accordance with ASTM C1611, Appendix X.1.
   e. Consolidation or reconsolidation is not required for self-consolidating grout.

2.16 SOURCE QUALITY CONTROL

A. Concrete Masonry Inspection
1. Refer to Division 01 Section "Quality Requirements".
2. Materials may require testing and retesting, as directed by the A/E, during the progress of the Work. Allow free access to material stockpiles, facilities and completed construction.
3. See structural plans for special inspection requirements for masonry walls.

B. Verification of Performance: Masonry Contractor shall water test cavity to verify all water is draining to the exterior through the weeps before continuing with exterior wythe and before capping wall.
1. Contractor shall perform initial tests in the presence of A/E, flexible flashing manufacturer, and General Trades Contractor. After successful initial tests have been performed additional testing shall be performed in the presence of the General Contractor so tests can be witnessed and documented.
   a. Do not precede more than 3 veneer courses above flashing without testing, observation and digital documentation by testing lab representative.

2. Contractor shall hold water hose and with standard water pressure, force water into the cavity at a cell vent so water can be observed coming out adjacent weeps for a period of at least 5 minutes. Contractor shall continue down the wall to the next cell vent where a weep did not indicate water wicking out and continue this process until the entire length of flashing is tested.
3. Where water is observed inside the building or outside the building away from the weeps, masonry units shall be removed and flashing reinspected and repaired.
4. Water test shall be repeated where flashing was repaired.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work in accordance with TMS 402/602, Article 2.1.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify critical steel elevations to ensure flashing will be installed at proper locations.
5. Verify dimensions, tolerances, and method of attachment to other work.
6. Verify that substrates are ready to receive the work of this section.

B. Before installation, examine rough-in and built-in construction for piping systems or conduit to verify actual locations of connections.
1. Do not install anything in the cavity space of the exterior wall that:
a. Diminishes the designed R-Value of the cavity-wall insulation.
b. Encroaches on the required air gap.

C. Verify substrate and surface conditions are in accordance with flexible flashing manufacturer recommended tolerances prior to installation.
1. Review requirements for sequencing of installation of flexible flashing assembly with installation of windows, doors, louvers and wall penetrations to provide a weathertight flashing assembly.
2. Verify flexible flashing will be continuously supported by substrate, and not span any gaps or voids in excess of 1/2 inch.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General
1. If ice or snow has formed on masonry bed, remove by carefully applying heat until top surface is dry to the touch.
2. Remove all masonry deemed frozen or damaged.
3. Provide items to be attached to substrate with setting templates.

B. Protect existing membrane roofing system. No masonry work is to be performed over an unprotected roof.
1. Loosely lay 1-inch minimum thick, molded expanded polystyrene (MEPS) insulation over the roofing membrane in areas indicated. Loosely lay 15/32-inch plywood or OSB panels over MEPS. Extend MEPS past edges of plywood or OSB panels a minimum of 1 inch.
a. Protection sheet or mat: Provide a sacrificial layer of matching membrane sheet extending minimum 6 inches beyond insulation in all directions or a woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.
2. Limit traffic and material storage to areas of roofing that have been protected.

C. Protect concrete floor from damage where floor will remain exposed.

D. Concrete Surfaces: Where masonry is to be placed, clean concrete of laitance, dust, dirt, oil, organic matter, or other foreign materials that would inhibit bond of mortar to the surface.

E. Furnish temporary bracing as required during installation of masonry work. Maintain in place until building structure provides permanent support.

3.3 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
   1. Note: In lieu of double wythe foundation walls, single wythe matching nominal overall width of double wythe may be provided.

B. Build chases and recesses to accommodate items specified in this and other Sections. Provide not less than 8 inches of masonry between chases or recesses and jamb of openings, and between adjacent chases and recesses.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
   1. Consult other trades and make provisions to permit installation of their work in a manner to avoid cutting and patching. Build in work specified under other Sections, as necessary, and as work progresses.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry, unless otherwise noted.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
   1. When units are above 32 deg. F, heat water above 70 deg. F.
   2. When units are below 32 deg. F, heat water above 130 deg F.
   3. Recommended procedure to insure that brick are nearly saturated, surface dry when laid is to place a hose on the pile of brick until the water runs from the pile. This should be done one day before brick are to be used. In extremely warm weather, place hose on pile several hours before brick are to be used.

H. Do not wet concrete masonry units.

I. Cleaning Reinforcement: Before being placed, remove loose rust, ice, or other coatings from reinforcement.

J. Re-installation of salvaged existing masonry:
   1. Replace removed damaged brick with other removed brick and salvaged brick in good quality, where possible, or with new brick matching existing brick, including size. Do not use broken units unless they can be cut to usable size.

2. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
    a. Maintain joint width for replacement units to match existing joints.
3. Lay replacement brick with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
    a. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
    b. Rake out mortar used for laying brick before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at same time as repointing of surrounding area.
    c. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

K. Temperature Control: Perform temperature-sensitive construction procedures while masonry Work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 10 deg F (6 deg C).
1. 40 to 32 Deg F (4 to 0 Deg C):
    a. Mortar: Heat mixing water to produce mortar temperature between 40 and 120 deg F (4 and 49 deg C).
    b. Grout: Follow normal masonry procedures.
2. 32 to 25 Deg F (0 to Minus 4 Deg C):
    a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C); maintain temperature of mortar on boards above freezing.
    b. Grout: Heat grout materials to 90 deg F (32 deg C) to produce in-place grout temperature of 70 deg F (21 deg C) at end of workday.
3. 25 to 20 Deg F (Minus 4 to 7 Deg C):
    a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C); maintain temperature of mortar on boards above freezing.
    b. Grout: Heat grout materials to 90 deg F (32 deg C) to produce in-place grout temperature of 70 deg F (21 deg C) at end of workday.
    c. Heat both sides of walls under construction using salamanders or other heat sources.
    d. Use windbreaks or enclosures when wind is in excess of 15 mph.
4. 20 Deg F (Minus 7 Deg C) and Below:
    a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 and 120 deg F (4 and 49 deg C).
    b. Grout: Heat grout materials to 90 deg F (32 deg C) to produce in-place grout temperature of 70 deg F (21 deg C) at end of workday.
    c. Masonry Units: Heat masonry units so that they are above 20 deg F (minus 7 deg C) at time of laying.
    d. Provide enclosure and auxiliary heat to maintain an air temperature of at least 40 deg F (4 deg C) for 24 hours after laying units.
5. Do not heat water for mortar and grout to above 160 deg F (71 deg C).

L. Masonry Protection: Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry, temperature ranges apply to anticipated minimum night temperatures.
1. 40 to 32 Deg F (4 to 0 Deg C): Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.

2. 32 to 25 Deg F (0 to Minus 4 Deg C): Completely cover masonry with weather-resistive membrane for at least 24 hours.
3. 25 to 20 Deg F (Minus 4 to 7 Deg C): Completely cover masonry with weather-resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.
4. 20 Deg F (Minus 7 Deg C) and Below: Except as otherwise indicated, maintain masonry temperature above 32 deg F (0 deg C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry, maintain heated enclosure to 40 deg F (4 deg C) for 48 hours.

3.4 TOLERANCES

A. General: Comply with construction tolerances in TMS 402/602 and the following:

B. Dimensions and Locations of Elements:
1. For dimension in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
4. If the above condition, cannot be meet due to previous construction, notify the A/E.

C. Lines and Levels
1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

D. Joints
1. Unless additional restrictions are indicated, horizontal mortar joints between masonry units shall be in the range of: 1/4 inch to 1/2 inch.
2. Vertical mortar joints between masonry units shall be in the range of: 1/8 inch to 3/4 inch.
3. For brick bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
4. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
5. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
6. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.5 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
   1. Do not install cracked, broken, or chipped masonry units exceeding ASTM allowances.
   2. Clean units of surface dirt and contaminants before placing in contact with mortar.
   3. Lay-up walls plumb and true and with courses level, accurately spaced, within specified tolerances, and coordinated with other work. Do not wedge partitions tight against structural ceiling or beams, but provide an acoustical joint between masonry and the structural roof deck, structural steel framing or structural floor deck at nonrated conditions. Refer to Division 07 Section “Acoustical Joint Sealants”. At rated walls, provide firestopping. Refer to Division 07 Section “Fire-Resistive Joint Systems.”
      a. Cut masonry as required to maintain 2 inches clearance between masonry and all steel or reinforced concrete structural members that pass through or above walls but are not to be supported by the walls.

B. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
   1. One-half running bond with vertical joint in each course centered on units in courses above and below, unless otherwise noted or required to match existing.
   2. Stack bond with Type “1” Black Bricks: Ebony Black Smooth; Belden Brick as indicated at Entry.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
   1. Align unit cells or cores that are to be grouted.

D. Stopping and Resuming Work: Stop work at vertical control joints or by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
   1. Stop off horizontal run of masonry by racking back 1/2 length of unit in each course.
   2. Toothing is not permitted, except upon written acceptance of the A/E.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
   1. Install adjustable hollow metal frame anchors, locating anchors on jambs in horizontal bed courses near the top and bottom of each frame and at intermediate points not over 24 inches apart.
   2. Unless otherwise noted or thermal break is required, contractor may grout jambs of hollow metal door and window frames in accordance with ANSI 250.8.
      a. Where grout is installed during masonry installation, frames shall be braced or fastened in such a way that will prevent the pressure of the grout from deforming the frame members. Grout shall be mixed to provide a 4 inch maximum slump consistency, hand troweled into place. Grout mixed to a thin “pumpable” consistency shall not be used.
   3. Rake joints around exterior side of exterior hollow metal door frames for sealant under Division 7.
   4. Protect inside (concealed) faces of door frames in exterior masonry walls, using fibered asphalt emulsion coating. Apply over shop primer approximately 1/8 inch thick and allow to dry before handling.
   5. Where hollow metal frames do not wrap around masonry jambs and heads, rub exposed corners of block to remove sharp, irregular edges.

6. Take particular care to embed all conduits and pipes with concrete masonry without fracturing exposed shells and to fit units around switch, receptacle and other boxes set in walls. Where electric conduits, outlets, switch boxes, and similar items occur, grind and cut units before building in services. Prepare cutouts in such a manner that units can be installed plumb and flush.
7. Install anchors, reglets, and nailers for flashing and related work built into masonry work, where indicated.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a grout stop (a layer of metal lath, wire mesh, or plastic mesh) in the joint below and rod mortar or grout into core.

G. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

H. Where non-loadbearing, full-height masonry walls intersect structural framing above, provide a minimum 1/2-inch clear joint around the member. Do not build masonry solid around open-web steel joists.
1. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section “Joint Firestopping”.
2. At non-fire-rated, but acoustically rated partitions treat joint between top of partition and underside of structure above to comply with Division 07 Section “Acoustical Joint Sealants”.

3.6 MORTAR BEDDING AND JOINTING

A. Mortar Bedding; Brick and Concrete Masonry Units as follows:
1. Mix mortar ingredients for a minimum of 5 minutes in a mechanical batch mixer. Use water clear and free of deleterious materials that would impair the work. Each mortar batch is allowed only one retempering. Do not use mortar, which has begun to set after the first retempering, or if more than 2-1/2 hours has elapsed since initial mixing. Retempering will be permitted only within 1-1/2 hours of mixing, to replace moisture lost by evaporation. Discard any mortar or grout that is partially set.
2. Lay brick and other solid masonry units with completely filled bed and head joints. Do not deeply furrow bed joints. Butter ends with sufficient mortar to fill head joints and shove into place. Butter ends of brick in hand and in the wall at closures. Do not slush head joints. Rock closures into place with head joints thrown against adjacent brick in place.
   a. Do not pound corners and jambs to fit stretcher units after they are set in position. Where an adjustment must be made after mortar has started to harden, remove mortar and replace with fresh mortar.
3. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells; also bed webs in mortar in starting course on footings and foundation walls, in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
   a. Construct bed joint of the starting course of foundation with a thickness not less than 1/4 inch and not more than 3/4 inch.
4. Remove mortar protruding into cells or cavities that will be grouted. Do not permit mortar droppings to fall into cells, cavities of multi-wythe walls or to block weep holes. Maintain clear cavity width between facing and backing material and keep clear of mortar droppings by back beveling the mortar bed to prevent excess from extruding into cavity. Clean any excess that does occur by parging it to back of unit.
5. Fill holes not specified in exposed and below grade masonry with mortar.

B. Joints: Maintain joint widths shown, except for minor variations required, to maintain bond alignment. Lay walls with 3/8-inch joints. Tool joints consistently with the same type of round jointer when the mortar is thumb print hard. Use a jointer that is slightly larger than the joint width so that complete contact is made along the edges of the unit. Tool joints in exposed masonry walls at uniform moisture content to avoid color variations. Perform tooling so that the mortar is compressed, and the joint surface is sealed. Cut joints flush for masonry walls that are to be concealed or to be covered by other materials. For exposed masonry, provide joints as follows:
   1. Exterior Joints
      a. Concave tooled, unless otherwise noted.
   2. Interior (Room Side) Joints
      a. Concave tooled, unless otherwise noted.

3.7 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:
   1. Individual Metal Ties: Provide where indicated only. Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
      a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
      b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.
   2. Masonry Joint Reinforcement: Provide unless otherwise noted**.** Install in horizontal mortar joints.
      a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes, if both wythes are concrete masonry and installed simultaneously. At no time shall a wythe be more than 16 inches higher than any other wythe being constructed concurrently.
      b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
      c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align. Wythes may be laid up full height separate from facing wythe.
         1) Cavity width changes shall be accommodated by different sized wire ties; wire ties should not be bent or deformed to span the cavity space.
   3. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
   1. Keep cavity clean of mortar droppings by suspending by wires a wooden strip the width of the air space. Strip shall be lifted as each course of joint reinforcement is laid in facing wythe. Install cavity mortar protection in cavity above through wall flashing and where indicated for additional protection.

3.8 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c., unless otherwise noted.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
      a. Reinforcement above is in addition to continuous reinforcement.

4. Provide reinforcement in every other course of concrete masonry veneer, but not in the same course as the tie.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.9 ANCHORING MASONRY TO STRUCTURAL STEEL

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.10 ANCHORING MASONR VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
1. Fasten screw-attached anchors through to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and exterior face of inner wythe or sheathing.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.
5. Masonry veneer anchors shall be embedded a minimum of 1-1/2 inches into the mortar joint. Provide a minimum of 5/8 inch mortar coverage at veneer to the outside face.

B. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing or insulation.
1. Keep air space clean of mortar droppings and other materials during construction. Bevel beds away from air space, to minimize mortar protrusions into air space. Do not attempt to trowel or remove mortar fins protruding into air space.

3.11 EXPANSION JOINTS (MOVEMENT JOINTS)

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Other than bond beams do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
1. Install an elastomeric tubing sealant backer rod at each control joint to compartmentalize masonry cavity.
2. Reinforcing and grout for masonry bond beams are to run continuous through vertical control joints.
3. Keep joints clean from all mortar and debris.

B. Form control joints in concrete masonry using one of the following methods:
   1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
   2. Install preformed control-joint gaskets designed to fit standard sash block.
   3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
   4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick made from clay or shale as follows:
   1. Build in compressible joint fillers, unless otherwise noted.

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.
   1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

E. Control Joint Locations in CMU: Provide vertical control joints in reinforced CMU where called for on the Drawings. Provide vertical control joints in unreinforced CMU in accordance with NCMA TEK Bulletins 10-01A, 10-02D, 10-03, and 10-04, and at all offsets, returns, openings, and intersections with dissimilar materials and as follows to prevent cracking:
   1. At change from wall setting on foundation to wall setting on floor slab.
   2. At change from exterior wall to interior wall.
   3. At walls setting on floors that cross floor construction.
   4. At columns within masonry walls.
   5. At changes in wall thickness.
   6. Stop joint reinforcement bars on either side of control joints. Extend reinforcing bars in bond beams continuously through control joints and sleeves for bond break 18 inches each side of joint.
   7. Install control joints in concrete masonry units with prefabricated shear key.
   8. At end of lintel bearing on one end of openings less than or equal to 6'-4" and at both ends of openings greater than 6'-4".
   9. Straight runs as indicated below, with spacing related to wall height as follows:
      a. Walls less than 8 feet: Not more than 3 times wall height.
      b. Walls 8 feet or higher: Maximum 25 feet.
   10. Distance between joints should not exceed the lesser of the following:
      a. A length-to-height ratio of 3 to 2.
      b. 25 feet.

F. Expansion Joint Locations in Brick: Provide in accordance with BIA Technical Note No. 18A at vertical expansion joints in brick masonry at all offsets, returns, openings, intersections with dissimilar materials, and elsewhere as shown on Drawings and indicated hereinafter. For brick work without openings, space no more than 25 feet o.c. Provide horizontal expansion joints by placing a continuous 3/8-inch pad below shelf angles, where indicated.
   1. Place as follows:
      a. At or near corners
      b. At offsets and setbacks
      c. At wall intersections
      d. At changes in wall height
      e. Where wall backing system changes
      f. Where support of brick veneer changes
      g. Where wall function or climatic exposure changes
      h. At one jamb of openings 12 feet or wider.
   2. Form open joint of width indicated but not less than 3/8 inch for installation of preformed expansion joint filler, and sealant and backer rod specified in Division 07 Section “Joint Sealants”. Maintain joint free and clear of mortar.

G. Building Expansion Joint Through Masonry
   1. Form open joint of width indicated but not less than 3/8 inch for installation of preformed expansion joint filler, and sealant and backer rod specified in Division 07 Section “Preformed Joint Seals”. Maintain joint free and clear of mortar.

3.12 LINTELS

A. Install loose steel lintels furnished under Division 05.
   1. Shore steel lintels until the masonry has attained sufficient strength to carry its own weight. Limit the deflection of masonry during this period to L/600 or 0.3 inch (whichever is less). This shoring period should not be less than 24 hour. This minimum time period should be increased to three days when there are imposed loads to be supported. If the masonry is built in cold weather construction conditions, the length of cure should be increased.

B. Provide masonry lintels where shown and wherever openings of more than 8 inches for brick size units and 16 inches for block size units are shown without structural steel or other supporting lintels. Provide prefabricated or formed-in-place masonry lintels. Do not use precast concrete lintels. Thoroughly cure prefabricated lintels before handling and installation. Temporarily support formed-in place lintels.
   1. For hollow masonry lintels, use specially formed "U"-shaped lintel units with solid bottom and reinforcing bars placed as shown, and filled with coarse grout. Bond beam block shall not be used to form masonry lintels.
   2. Bond pattern for masonry lintels shall match the pattern at the adjacent wall unless otherwise noted.

C. Provide minimum 8-inch solid bearing at each end, unless otherwise noted. Provide solid masonry units or hollow units filled solid.
   1. Provide a slip plane in the form of flashing or other bond breaker between the lintel and masonry in unreinforced CMU walls.

D. For steel lintels in exterior wythe, rake back mortar in preparation for sealant as specified in Division 07 Section “Joint Sealants”.

E. Where formed-in-place masonry lintels are supported by steel angles over the opening during installation, the angles shall not extend more than 2-1/2 inches into the masonry on each jamb of the opening. When the angles are removed, the void remaining shall be packed tightly with a moist mixture of Type S mortar.

F. The reinforced masonry and lintel drawings are intended to show the major lintels required for windows, doors, louvers, and other major openings. Some lintels are shown for some mechanical duct and pipe openings, but the drawings are not intended to show all of these openings. The masonry contractor shall coordinate the size and location of openings required in masonry walls by the other contractors and provide steel or masonry lintels for these openings according to the lintel schedules in the Contract Documents whether shown on the Contract Documents or not.

3.13 FLASHING, WEEPS, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep vents in first course of masonry above ground level, at lintels, ledges, above doors, windows and other openings and under coping and sills, other obstructions to downward flow of water in wall. Flashing shall be installed longitudinally continuous or terminated with end dams. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities. Comply with NCMA recommendations for “drainage wall system” masonry construction.
   1. Install concealed through wall flashing in accordance with SMACNA “Architectural Sheet Metal Manual” Chapter 4 Flashing and with NCMA TEK Bulletins 19-04A and 19-05A details to ensure water resistant masonry construction.
   2. Apply primer, if required by manufacturer according to manufacturer’s written instructions.

3. Install preformed corners and end dams, cants, if required, under flexible flashing membrane, bedded in sealant in appropriate locations along wall.
4. Starting at a corner, remove release sheet, if applicable, and apply membrane to primed, if required by manufacturer for substrate indicated.
5. Extend membrane through wall and leave 1/4 inch minimum exposed.
6. Roll flashing into place. Ensure continuous and direct contact with substrate. Avoid trapping air and forming wrinkles.
7. Lap ends and overlap preformed corners 4 inches minimum. Seal all laps with sealant.
8. Trim exterior edge of flexible flashing membrane 3/4 inch and secure to metal drip edge per manufacturers written instructions, where drip edge is required.
    a. Embedded flashing materials shall not be used for drip edges.
9. Terminate flexible flashing membrane on vertical wall with a termination bar.
10. Apply sealant bead at each termination.
11. Protect installed flexible flashing from damage during construction.
    a. Inspect before covering and make repairs as necessary. Remove and replace damaged material. Repair holes and tears by covering with cut patch of similar product overlapping damage 2 inches minimum. Seal perimeter of patch repair with sealant/mastic.
    b. Cover flexible flashing as soon as possible after installation has been observed and tested. Do not expose longer than 60 days, unless otherwise approved by membrane manufacturer in writing.

B. Install flashing as follows, unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
    a. Install proprietary flashing/drainage system in accordance with manufacturer's installation instructions.
2. At multiwythe masonry walls, including cavity walls, where wall intersects a roof or similar horizontal element, extend flashing through outer wythe, turn up 16 inches or a minimum of 6 inches above cavity mortar protection, and terminate on exterior face of inner wythe with termination bar and sealant. Install metal reglet/receiver, extending through cavity and turned up at exterior face of inner wythe, beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal reglet/receiver.
    a. Note: Embedded flashing must terminate a minimum of 12 inches above roofing surface. Coordinate termination with roofing contractor.
3. At multiwythe masonry walls, including cavity walls, where wall intersects grade, extend flashing through outer wythe, turn up 16 inches or a minimum of 6 inches above cavity mortar protection, and terminate on exterior face of inner wythe with termination bar and sealant. Cut flexible flashing off flush at face of wall after masonry wall construction in completed.
4. At lintels extend flashing over top flange of angle across air space behind veneer and turn up a 16 inches or a minimum of 6 inches above cavity mortar protection, and terminate on exterior face of inner wythe or sheathing with termination bar and sealant. At outer wythe extend flashing at least 6 inches beyond end of lintel and turn up ends not less than 2 inches to form end dams. Install metal drip edges beneath flexible flashing at exterior face of wall and seal with sealant to lintel. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
    a. Where the lintel is bolt-mounted in place, cut-off excess bolt length at face of nut prior to installing the flexible flashing. After positioning the flexible flashing, cut a small "X" in the flashing to allow the flashing to fit over the nut and then apply compatible mastic to the flashing a minimum of 1 inch out from the "X" in all directions.

C. Install weep vents in head joints in exterior wythes of first course of masonry immediately above embedded flashing (not mortar) and as follows:

1. Use specified weep/vent products to form weeps.
2. Space weep vents 16 inches o.c., unless otherwise indicated.
3. Keep weep holes and area above flashing free of mortar droppings.

D. Place cavity mortar protection material in cavities to comply with configuration requirements for cavity mortar protection material in Part 2 "Miscellaneous Masonry Accessories" Article.
1. Option: Use geotextile drainage fabric as recommended by flashing manufacturer and install to have the fabric reach the base of the flashing and covering the weep vents.
a. Inspect flashing for holes prior to installing fabric mesh. Coordinate repair of holes with installer of flashing.
b. Place a continuous row of fabric mesh one inch into the mortar joint of the third row of standard size exterior bricks in collar joints, cavity walls, or lintels. Drape excess material onto base of flashing. Ensure that flashing is clean of mortar droppings and debris. Adhesives and fasteners are not required; mortar need not have set.
c. If excessive droppings are expected, use a taller height fabric mesh and taller flashing.
d. Cut or tear to accommodate wall ties, conduit, plumbing or other materials that bridge or intrude into cavity between inner and outer walls.

E. Install vents in head joints in exterior wythes at 32 inches o.c., unless otherwise indicated. Use specified weep/vent products to form vents.
1. Close cavities off vertically with elastomeric tube sealant back rod in manner indicated. Install through-wall flashing and weep vents above horizontal blocking.

3.14 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 402/602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in TMS 402/602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. The low-lift grouting procedure shall be used as described in the Drawings and in NCMA-TEK 03-02A Grouting Concrete Masonry Walls.
a. High-Lift Grouting: Do not use unless approved by A/E. If high-lift grouting is approved, limit lifts to 12’-0” and use super plasticizer in grout to reduce water content.
3. Grout (slump 8 to 10 inches) shall be installed in the block cavities so as to completely fill each cavity with homogenous grout, extending from the lowest course to the top of the reinforced portion of the foundation or wall. Concrete or mortar shall not be used as grout for CMU.
4. Between 5 and 20 minutes after the grout is placed, it shall be consolidated with a mechanical vibrator. The top of the grout filling shall be stopped 1-1/2 inches below the top of the concrete block to form a key, except for the top course in the wall where the grout shall be struck flush with the top.
5. Aggregate used in the grout shall be small enough not to interfere with placement and plasticity.

6. Caging devices and centering clips shall be spaced vertically such that 2 clips or devices, one near its top and one near its bottom restrain every section of vertical reinforcing bar.
7. Where grouted cores do not extend the full height of a wall, install grout stop mesh at the lower limit of the grout.
8. Where required on the plans, grouting operations shall be observed by an independent testing agency.

3.15 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage qualified independent inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during sampling and placing of masonry units, placement of reinforcement, inspection of grout space and during grouting operations. The masonry inspector shall assure Contractor compliance with drawings and specifications**,** including flashing. The masonry inspector shall keep a complete record of all inspections and shall submit Masonry Inspection Reports and Special Inspection requirements set forth in the structural drawings for inspection requirements and a photographic documentation of flashing.
   1. Masonry Inspection: Provide masonry construction inspection of concrete or brick masonry walls indicated as requiring inspection on the Masonry Plans to insure that masonry construction is in conformance with the Contract Documents. Masonry inspection is required for those masonry elements that must be constructed to attain high design strengths.
      a. Inspection shall use NCMA-TEK 18-03B “Concrete Masonry Inspection” as a guideline.
      b. The individual or individuals who will perform the masonry inspection shall be present for the Preliminary Masonry Meeting.
      c. The masonry inspector shall prepare a written report or reports for each day of inspection. Masonry Inspection Report, following this Section, shall be used for all inspection reports. Inspecting reports shall be submitted to the A/E within 5 days of masonry inspection.
      d. The masonry inspector shall be present and observe all masonry construction operations in walls requiring inspection. The masonry inspector shall be present at the Project site within sufficient time, in advance of grouting operations, to inspect the construction to insure its conformance to the Contract Documents and that grouting may proceed. No grouting shall be permitted unless the masonry inspector is present and has indicated that the masonry construction is properly prepared for the grouting operation.
   2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspection according to the "TMS 402," unless otherwise noted.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grouts only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140 for compressive strength.
   1. Tests of Concrete Masonry Prisms: The Masonry Contractor shall coordinate with a qualified testing laboratory to perform field quality control testing during the masonry work.

a. When prism tests are required to establish the strength of masonry in lieu of Masonry Inspection, provide a minimum of one set of 3 masonry prisms for testing for each 5000 sq.ft. (gross) of masonry wall construction.
b. Submit written reports for each prism tested. Provide the project identification name and number, date of report, name of Contractor, name of testing service, name of material suppliers, specific location where masonry represented by the prism is used, compression test strength results, and specified required strength.
c. If the compressive strength tests fail to meet the minimum strength specified in the Plans, the masonry represented by the tests shall be considered deficient.
d. When tests indicating deficient masonry represent masonry already constructed, such masonry shall be removed and replaced by the Contractor without additional cost to the Owner. In lieu of removal and replacement, additional cores may be grouted as required and directed by the A/E without additional cost to the Owner.

E. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.
1. Approved method for testing grout specimens is by using a grout mold comprising the concrete masonry units used on the Project (commonly called a “pinwheel”).
2. Cap the specimens in accordance with the applicable provisions of "Method of Capping Cylindrical Concrete Specimens," ASTM C617. The specimens shall be tested in a damp condition in accordance with the applicable provisions of ASTM C39 "Methods of Test for Compressive Strength of Molded Concrete Cylinders."
3. Four test specimens shall be made and tested for each type of grout to be used in the work.
4. As an alternate to the method of sampling described above, grout samples may be formed in grout sample boxes, when requested and approved by A/E.
5. Tests for Grout: The Masonry Contractor shall coordinate with a qualified testing laboratory to perform field quality control testing during the masonry grout work.
a. Grout for filling reinforced or unreinforced concrete masonry cores or brick cavities: Test for compressive strength.
1) Provide a minimum of 4 test specimens for testing per 5,000 sq.ft. of masonry wall construction or for each ready-mix truckload of grout and as directed by the A/E. Test one cylinder at 7 days, two cylinders at 28 days, and reserve one cylinder for future testing.
b. Submit written reports for each material sampled and tested. Provide the project identification name and number, date of report, name of Contractor, name of testing service, source of aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, specific location where material represented by sample is used, slump and compression test results. Indicate whether material is acceptable for intended use.

F. Prism Test: For each type of construction provided, per ASTM C 1314 at 7 days and at 28 days.

3.16 REPAIRING, POINTING, AND CLEANING

A. Cleaning, General
1. Know your surface. Positively identify every substrate to be cleaned. Review all manufacturers literature for cleaning recommendations.
2. Always test before overall cleaning. Always test, and always clean under the same conditions you tested under. Retest if conditions change.
3. Use the mildest cleaner and dilution that still gives effective results.
4. Clean early:
a. Don’t give mortar smears and films a chance to become as hard as the masonry. Get if off while it’s still relatively soft. Clean masonry within 7 to 21 days of installation.
b. Clay brick maybe cleaned within 14 to 28 days.
5. Use the right cleaner for the right job. Follow the masonry manufacturer’s guidelines for cleaning each type of masonry.

6. Never clean with raw acid.
7. Cleaning basics
    a. Don’t spare the water. Pre-wetting masonry is recommended. Rise with 400 psi to remove stains and cleaner residue.
    b. Clean bottom-to-top, and always keep lower areas wet to prevent streaking.
    c. Follow all safety precautions in the product literature.
    d. Cold weather
        1) Water-saturated masonry is vulnerable to freeze/thaw damage. Never clean if the masonry could freeze before drying.
        2) Chemical cleaners and rinse water rely on chemical reactions to dissolve and rinse away construction soiling. Cold temperatures slow these chemical reactions. Compensating for the cold by using a stronger cleaning solution may cause permanent damage to the masonry, especially colored concrete.
            a) Instead, extend the dwelling time of the properly diluted cleaning solution by 10-20 percent. Scrub areas of heavy soiling with a masonry washing brush. Pre-wetting and rinsing with hot water warm surface and improves results.
        3) Schedule wet cleaning for when air and surface temperatures are 40 deg. F. and rising. In cold weather this means your wet-cleaning window may be only a few hours. Use the time before and after to dry-brush and scrape away heavy accumulations of excess mortar and job dirt from the next day’s work area.
        4) If a limited cleaning window is impractical, enclose the work area with polyethylene and use approved heaters to warm masonry.
        5) Warm weather test panels won’t work for cold weather cleaning. Test in cold clean in cold.

B. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

C. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
1. Tuckpointing
    a. Rake mortar joints to a depth of not less than 1/2 inch nor more than 3/4 inch.
    b. Saturate joints with clean water.
    c. Fill solidly with pointing mortar.
    d. Tool joints.

D. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints. Dry brush exposed masonry with bristle brushes at end of each workday.
1. Promptly remove excess wet mortar containing integral water-repellent mortar admixture from the face of the masonry as work progresses. Do not use strong acids, over-aggressive sandblasting or high-pressure cleaning.

E. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes or use methods used on approved mock-up. Obtain A/E's approval of sample cleaning before proceeding with cleaning of masonry.
    a. Comply with applicable environment laws and restrictions.
3. Protect adjacent non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
   a. Remove efflorescence in accordance with brick manufacturer's recommendations. Cleaning agents may be used only with approval of masonry unit manufacturer. Cleaning agents must be same as those used on test area.
   b. If chemical cleaners are to be sprayed on, the pressure shall not exceed 50 psi.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean concrete masonry by cleaning method indicated in NCMA TEK 08-02A and 08-03A, applicable to type of stain on exposed surfaces.

3.17 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess clean masonry waste and other masonry waste and legally dispose of off Owner's property.

END OF SECTION 04 20 00.00

05 METALS

DIVISION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes structural steel framing, including, but not limited to, following:
   1. Miscellaneous angles, channels, anchor bolts, bent plates, sleeves, sag rods, leveling plates, bearing plates for structural steel and steel joists, and other incidental items of structural steel required to be built into concrete or masonry shall be provided as indicated or specified and be furnished to respective trades at proper time; including instructions and templates for their installation.
   2. Provide, where specifically called for, loose lintels, perimeter angle closure, and accessories.
   3. For openings in metal deck 12 by 12 inches and larger, provide steel reinforcing members on all sides of opening, as indicated. Openings in deck shall be cut under Division 05, Section “Steel Decking”.
   4. Shear stud connectors.
   5. Shrinkage-resistant grout.

B. Related Sections include following:
   1. Division 01 Section “Summary” for load bearing structural steel definition.
   2. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
   3. Division 05 Section "Steel Decking" for field installation of shear connectors.
   4. Division 05 Section "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
   5. Division 09 painting Sections for coordination with primer for surface preparation and priming requirements.

C. Use of Domestic Steel: For this Project all load-bearing structural steel (as defined in Division 01 Section “Summary”) shall be fabricated, and produced using, to the best of the General Contractor’s knowledge, only steel made in the United States in accordance with Sections 153.011 and 153.99 of the Ohio Revised Code (ORC).

1.2 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's 303 "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination
   1. Furnish anchorage items to be embedded in or attached to other construction without delaying Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
   2. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. Structural-steel materials.
   2. High-strength, bolt-nut-washer assemblies.
   3. Shear stud connectors.
   4. Anchor rods.
   5. Threaded rods.

6. Forged-steel hardware.
7. Slide bearings.
8. Shop primer.
9. Galvanized-steel primer.
10. Etching cleaner.
11. Galvanized repair paint.
12. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemented fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed and prepared by qualified professional engineer responsible for their preparation.
6. Indicate areas to be left unprimed, surfaces primed and where members will be galvanized.
7. Structural steel shop drawings are to be submitted by complete phase or sequence including all beams and columns required for that area. Incomplete or partial shop drawings will not be reviewed. Subsequent phase or sequence submittals must be clearly delineated on erection plans from previous submittals.
8. Resubmitted shop drawings must have all revisions clearly marked. Resubmitted drawings which do not have revisions marked will not be reviewed.

C. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product Test Reports
1. Bolts, nuts, and washers including mechanical properties and chemical analysis
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors
5. Shop primers
6. Grout

B. Qualification Data: For Installer, fabricator, and professional engineer.

C. Source quality-control test reports, when applicable.

1.6 QUALITY ASSURANCE

A. Qualifications: Structural fasteners shall be manufactured in United States. Fabricator shall furnish proof of U.S. manufacturer. If it becomes necessary to use imported fasteners, each size, type, and each large quantity package (500 pcs. or more) shall undergo a random sampling of a minimum 5 pieces for testing. Test results are to be provided to A/E. Test shall be performed by an independent testing agency, and cost shall be included in Base Bid. If inferior fasteners are discovered, all fasteners of that type shall be removed and replaced with acceptable fasteners at no cost to Owner. If possible, fasteners shall be tested prior to use in construction.

B. Fabricator Qualifications: A qualified fabricator who participates in AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspector Program for Structural Steel (Acceptance Criteria 172).
   1. Firms acceptable as fabricators for structural steel work under this Section shall be certified in category of “Standard for Steel Building Structures (BU)” by American Institute of Steel Construction or shall include in their bid amount of $3000 to cover cost of inspections by an independent testing agency to verify that fabricator is capable of performing desired level of quality in work to be performed. Fabricator shall cooperate with and make available to testing agency records and documents which focus on general management, engineering and drafting, procurement, operations and quality control and shall allow access to facilities to allow testing agency to examine actual fabrication work in shop and drafting room at time of inspection. Inspection will be performed prior to signing of a contract between Owner and Fabricator and will be basis of recommendations from A/E to Owner as to qualifications of fabricator to perform work.

C. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade 1852 fasteners and for retesting fasteners after lubrication.

C. Waste Management and Disposal; As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.
   2. Separate corrugated cardboard and packaging in accordance with Waste Management Plan and place in designated areas for recycling.
   3. Fold up metal banding, flatten, and place in designated areas for recycling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide product by manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed material requirements and functional qualities of specified product. “Substitution Request Form” and complete technical data for evaluation must accompany request for A/E’s approval. All materials for evaluation must be received by Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of following specifications and documents:
   1. ANSI/AISC 303.

B. Connection Design Information
   1. Option 3 and 3A: Design connections in accordance with ANSI/AISC 303 by fabricator’s qualified professional engineer. Member reinforcement at connections is indicated on drawings.
      a. Use Allowable Stress Design; data are given at service-load level.

2.3 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992 or ASTM A 572, Grade 50.

B. Channels, Angles, M, S-Shapes: ASTM A 36 or ASTM A 572, Grade 50.

C. Plate and Bar: ASTM A 36, unless otherwise noted.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53, Type E or S, Grade B.
   1. Weight Class: Standard, unless otherwise noted.
   2. Finish: Black, except where indicated to be galvanized.

F. Steel Castings: ASTM A 216, Grade WCB with supplementary requirement S11.

G. Steel Forgings: ASTM A 668.

H. Welding Electrodes: Comply with AWS requirements.

2.4 BOLTS AND CONNECTORS

A. High-Strength A 325 Bolts, Nuts, and Washers: ASTM F 3125, Grade A 325, Type 1, heavy hex steel structural bolts; ASTM A 563, Grade DH, heavy hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.
   1. Use 3/4 inch bolts, unless otherwise noted.
   2. Finish: Plain, unless otherwise noted.
      a. Provide hot-dip zinc coating, ASTM A 153, Class C, where indicated.
   3. Direct-Tension Indicators: ASTM F 959, Type 325-1 compressible-washer type may be used as Contractor’s option.
      a. Finish: Plain, unless otherwise noted.

B. High-Strength A 440 Bolt-Nut-Washer Assemblies: ASTM F 3125, Grade A 490, Type 1, heavy hex or round head steel structural bolts or Grade F 2280 tension-control, bolt-nut-washer assemblies with splined ends; with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436, Type 1 hardened carbon-steel washers.
   1. Finish: Plain, unless otherwise noted.
   2. Direct-Tension Indicators: ASTM F 959, Type 490-1 compressible-washer type and plain finish.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

2.5 RODS

A. Un-headed Anchor Rods: ASTM F 1554, Grade 36.
   1. Configuration: Straight, unless otherwise noted.
   2. Nuts: ASTM A 563 hex carbon steel.
   3. Plate Washers: ASTM A 36 carbon steel.
   4. Washers: ASTM F 436, Type 1, hardened carbon steel.
      a. To be used with 3/4 inch diameter anchor rods with maximum 1-1/16 inch hole in base pate.
   5. Finish: Plain, unless otherwise noted.
      a. Provide hot-dip zinc coating, ASTM A153, Class C, where indicated.

B. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
   1. Nuts: ASTM A 563 heavy hex carbon steel.
   2. Plate Washers: ASTM A 36 carbon steel.
   3. Washers: ASTM F 436, Type 1, hardened carbon steel.
      a. To be used with 3/4 inch diameter anchor rods with maximum 1-1/16 inch hole in base pate.
   4. Finish: Plain, unless otherwise noted.

C. Threaded Rods: ASTM A 36.
   1. Nuts: ASTM A 563 hex carbon steel.
   2. Washers: ASTM A 36 carbon steel.
   3. Finish: Plain, unless otherwise noted.
      a. Provide hot-dip zinc coating, ASTM A153, Class C, where indicated.

2.6 FORGED-STEEL STRUCTURAL HARDWARE AND ACCESSORIES

A. Clevises and Turnbuckles: ASTM A 108, AISI C-1035, cold-finished carbon steel.

B. Eye Bolts and Nuts: ASTM A 108, AISI C-1030, cold-finished carbon steel.

C. Sleeve Nuts: ASTM A 108, AISI C-1018, cold-finished carbon steel.

2.7 SLIDE BEARINGS

A. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of following:
      a. Amscot Structural Products Corp.
      b. Fluorocarbon Company Limited.
      c. GRM Custom Products.
      d. R.J. Watson Bridge and Structural Engineered Systems.
   2. Mating Surfaces: PTFE and PTFE.
   3. Coefficient of Friction: .04 to .06.
   4. Design Load: Not less than 2,000 psi.
   5. Total Movement Capability: 2 inches.

2.8 PRIMER

A. Steel Primer:
   1. Unless otherwise noted, provide fabricator's standard lead-and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI #79 or SSPC-Paint 23 and compatible with topcoat.

2. Comply with Division 09 painting Sections where structure is exposed and painted.

2.9 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
   1. Products:
      a. Five Star Fluid Grout 100; Five Star Products, Inc.
      b. Crystex; L&M Construction Chemicals, Inc.
      c. Sure-Grip High Performance Grout; Dayton Superior Corp.
      d. Sealtight Pac-it Grout; W. R. Meadows, Inc.
      e. Enduro 50; Conspec Marketing & Manufacturing Co., Inc.
      f. NS Grout: The Euclid Chemical Company

2.10 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's 303 and AISC's 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning", unless otherwise noted.

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

H. Masonry Bearing Plates
   1. All joists shall bear on masonry bearing plates with anchor rods or headed studs embedded in masonry below. Weld joists to bearing plates in accordance with SJI Specifications. See Framing Details and Plans for bearing plate sizes.
   2. All beams shall bear on masonry bearing plates with anchor rods or headed studs embedded in masonry below. Do not weld beams to bearing plates unless otherwise noted. See Framing Details and Plans for bearing plate sizes.
   3. Set bearing plates under Work of Division 04 Section “Unit Masonry”.

2.11 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings not less than 8 inches, unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.12 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates after fabrication.

2.13 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened, unless otherwise noted.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

2.14 SHOP PRIMING

A. Shop prime steel surfaces except following:
   1. Interior members permanently concealed (enclosed) in finished construction.
      a. All interior steel not exposed to view in final structure shall be shipped with no paint and no surface prep, unless otherwise noted.
      b. All interior stock, exposed to be painted, shall receive a primer compatible with topcoats as specified in Division 09 Section “Interior Painting”.
   2. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
      a. Bituminous coating shall be applied to all steel encased in concrete and/or masonry below grade.
   3. Surfaces to be field welded.
   4. Surfaces to be high-strength bolted with slip-critical connections.
   5. Galvanized surfaces.
      a. All exterior steel that is exposed to weather shall be galvanized, unless a high performance finish system is required.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to following specifications and standards:
   1. SSPC-SP 2, "Hand Tool Cleaning," unless otherwise recommended by paint manufacturer for application indicated.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP16.

D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.15 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to structural steel according to ASTM A 123.
   1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
   2. Fill vent holes and drain holes that are exposed in finished work unless they function as weep holes by plugging with zinc solder and filling off smooth.
   3. Galvanize all steel (both beams and angles, including lintels) located in exterior walls.

2.16 SOURCE QUALITY CONTROL

A. Owner shall engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports when fabricator is not certified. Cost of tests and inspections shall be paid by Owner and deducted from $3000.00 allowance.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
   2. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A490 Bolts."
   3. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.
   4. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
      a. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
      b. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
   5. Correct deficiencies in Work that test reports and inspections indicate do not comply with Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedment, with steel erector present, for compliance with requirements.
   1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedment showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to:
   1. AISC 303 and AISC 360
   2. OSHA Construction Industry Standards (29 CFR 1926)
   3. Specified requirements

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
   1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of base plate.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed, unless otherwise noted. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.
   1. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.
   2. Refer to Division 03 of these Specifications for anchor bolt installation requirements in concrete, and Division 04 for masonry installation, if required.
   3. Where anchor bolts are broken after installation, concrete shall be removed around remaining portion of bolt in concrete to a depth of 1/2 inch below top of bolt. A new segment of bolt of same steel strength shall be full penetration welded to remaining bolt in concrete. New segment of bolt shall be tapered on welded end to a 30-degree bevel all around to leave a thickness at beveled end of 1/4 inch.
   4. Where anchor bolts are incorrectly located in concrete or masonry that encases them, following procedures shall be used.
      a. For bolt misalignment less than 5/16 inch: offset column with base plate as required to locate column correctly. 5/16 inch oversized holes in column base plates will allow this movement without modification to column or anchor bolts.
      b. For bolt misalignment more than 5/16 inch and less than 2 inches: cut and remove base plate from column, relocate base plate and reweld to column.
      c. For bolt misalignment more than 2 inch and less than 6 inches: cut off anchor bolts flush with surface of concrete or masonry and install adhesive anchor bolts.

D. Lintels: Weld or bolt members together where indicated.
   1. Lintels shall have 8 inch bearing at each end, minimum, unless shown otherwise. Bearing pressures shall not exceed allowable stress for masonry.

E. Maintain erection tolerances of structural steel within AISC's 303.

F. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

G. Splice members only where indicated.

H. Do not use thermal cutting during erection.

I. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

J. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, unless otherwise noted.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
1. Comply with AISC's 303 and 360 for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform following special inspections.
1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connection.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
1. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
2. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
a. In addition to visual inspection, field welds may be tested according to AWS D1.1 and following inspection procedures, at testing agency's option:
1) Liquid Penetrant Inspection: ASTM E 165.
2) Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3) Ultrasonic Inspection: ASTM E 164.
4) Radiographic Inspection: ASTM E 94.

C. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with Contract Documents.

3.6 ERECTION ALIGNMENT

A. Framing: Framing shall be built up true, plumb, and level within a tolerance of 1:500; and temporary bracing shall be introduced, wherever necessary, to take care of loads to which structure may be subjected, including erection equipment and its operation. Such bracing shall be left in place as long as may be required for safety. Contractor as part of his equipment shall finally remove it. As erection progresses, Work shall be securely connected to take care of dead load, wind, and erection stresses.

3.7 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
   2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
   3. Cleaning and touchup painting are specified in Division 09 Section “Interior Painting” when structure will be painted.

END OF SECTION 05 12 00

SECTION 05 21 00 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. K-series steel joists.
   2. LH and DLH long-span steel joists.
   3. Joist accessories.
      a. When outriggers, angles, or other components are attached to the open web steel joists in the shop, in such a way that they actually are a component part of the joists, they are to be provided under this Section.
      b. The Work includes bridging and bridging anchors, sag rods, wall anchors, and beam anchors.

B. Related Sections include the following:
   1. Division 05 Section "Structural Steel Framing" for bearing plates.
   2. Division 05 Section “Metal Fabrications” for adhesive anchor bolts and bearing plates.

1.2 DEFINITIONS

A. SJI "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product indicated.

B. Shop Drawings:
   1. Show layout, designation, number, type, location, and spacings of joists.
   2. Include joining and anchorage details, bracing, bridging, joist accessories; splice and connection locations and details; and attachments to other construction.
   3. Indicate locations and details of bearing plates to be embedded in other construction.
   4. Indicate where members are to be unprimed and are to be primed or primed with primers compatible with topcoats.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Manufacturer Certificates: Signed by manufacturers stating that work was performed in accordance with approved construction documents and with SJI standard specifications.

B. Mill Certificates: Signed by bolt manufacturers certifying that bolts comply with requirements.

C. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
   1. Submit design calculations with a cover letter bearing seal and signature of the joist manufacturer's registered design professional. In addition to standard calculations under seal and signature, submittal of the following shall be included:
      a. Joists with special loading conditions.
      b. Non-SJI standard bridging details (e.g., for cantilevered conditions, net uplift, etc.).
      c. Connection details for
         1) Non-SJI standard connections (e.g., flush-framed or framed connections);
         2) Field splices;

3) Joist headers.

D. Qualification Data: For manufacturer and professional engineer.

E. Steel-joist placement plans: Shall include, at a minimum, the following:
1. Listing of all applicable loads as used in the design of the steel joists and joist girders as specified in the construction documents.
2. Profiles of nonstandard joist and girder configurations.
3. Connection requirements for:
   a. Joist supports;
   b. Joist girder supports;
   c. Field splices; and
   d. Bridging attachments.
4. Deflection criteria for live and total loads for non-SJI standard joists.
5. Size, location, and connections for all bridging.
6. Joist headers.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.
1. A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables of SJI "Specifications."
2. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements. This responsibility includes preparation of shop drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installation of joists that are similar to those indicated for this Project in material, storage, and extent.

C. SJI Specifications: Comply with standard specifications in SJI's "Specifications" that are applicable to types of joists indicated.

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

C. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
1. Collect cut-offs and scrap and place in designated area for recycling in accordance with the Waste Management Plan and local recycler standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Canam Steel Corporation; Canam Group, Inc.
   2. Gooder-Henrichsen Co.
   3. New Millennium Building Systems, LLC
   4. Structures of U.S.A., Inc.
   5. Valley Joist
   6. Vulcraft; Nucor Corporation.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
   1. Use basic load cases shown on drawings.
   2. Design special joists to withstand design loads with live load deflections no greater than the following:
      a. Roof Joists: Vertical deflection of 1/240 of the span.

2.3 MATERIALS, GENERAL

A. Steel: Comply with SJI, Federal Register 29 CFR 1926 and with AISC "Standard Specifications."
   1. Yield strength used as a basis for the design stresses shall be as follows:
      a. Chords = 50,000 psi
      b. Webs = 36,000 psi or 50,000 psi
   2. Evidence that the steel furnished meets or exceeds the design yield strength shall be provided, on A/E's request, in the form of certified test reports.
   3. Deduct the area of holes in chords from the area of the chord when calculating the strength of the member.

2.4 PRIMERS

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15, unless otherwise noted.

C. Primer: Provide shop primer that complies with Division 09 Section “Interior Painting, where joists will be exposed and painted.

2.5 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
   1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Top-Chord Extensions and Extended Ends: Provide cantilevered ends of joints with either Type S-top chord extensions or Type R extended ends as required for the loads indicated. Unless indicated otherwise, design cantilevered ends for the same pound-per-linear-foot capacity as the main span of the joist.

E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

F. Camber joists according to SJI's "Specifications."

G. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.6 LONG-SPAN STEEL JOISTS

A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series", and Super Longspan Steel Joists, SLH Series, in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Camber long-span steel joists according to SJI's "Specifications."

E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.7 JOIST ACCESSORIES

A. Bridging: Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

B. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
   1. Finish: Plain, uncoated, unless otherwise noted.
      a. Provide hot-dip zinc coating, ASTM A 153, Class C, where indicated.

C. High-Strength Bolts, Nuts, and Washers: ASTM F 3125, Grade A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
   1. Finish: Plain, uncoated, unless otherwise noted.
      a. Provide hot-dip zinc coating, ASTM A 153, Class C, where indicated.

D. Welding Electrodes: Comply with AWS standards.

E. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.8 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or SSPG-SP3, unless otherwise noted or required by paint manufacturer.

B. Apply 1 coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick, unless otherwise noted.

C. Shop priming of joists and joist accessories is specified in Division 09 Section "Interior Painting" where joists will be exposed and painted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
   1. Before installation, splice joists delivered to Project site in more than one piece.
   2. Space, adjust, and align joists accurately in location before permanently fastening.
   3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
   4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joist to supporting steel framework using carbon-steel bolt, where indicated.
   1. Provide high-strength structural bolts, where indicated. Comply with Research Council on Structural Connections' "Specification for Structural Joints Using ASTM F 3125, Grade A325 or A490 Bolts" for high strength structural bolt installation and tightening requirements.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

F. Anchors: Bridging shall extend to walls or beams and shall be anchored thereto before construction loads are placed on the joists.

G. Support of Other Work: Suspension wires, straps, chains, etc. used to support lights, ceiling grid, ductwork piping conduit, etc. shall be hung from top or bottom chord panel points.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following procedures, as applicable:
    a. Radiographic Testing: ASTM E 94.
    b. Magnetic Particle Inspection: ASTM E 709.
    c. Ultrasonic Testing: ASTM E 164.
    d. Liquid Penetrant Inspection: ASTM E 165.

C. Bolted connections will be visually inspected.
1. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

E. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, unless otherwise noted.
1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

B. Touchup Painting: Cleaning and touchup painting are specified in Division 09 Section "Interior Painting", where joists will be exposed and painted.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 21 00

SECTION 05 31 00 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes following:
   1. Roof deck, unless otherwise noted.

B. Related Sections include following:
   1. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
   2. Division 09 Section “Suspended Modular Ceiling Modules” for coordination.
   3. Division 09 Section "Interior Painting" for painting of deck.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated, including dimensions of individual components, profiles, and finishes.

B. Shop Drawings: Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of following complies with requirements:
   1. Power-actuated mechanical fasteners.
      a. Provide calculations in accordance with IIC-ES AC43 or SDI design method verifying allowable diaphragm shear strength and stiffness.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with applicable provisions of the following specifications:
   1. AISI S100-16, North American Specification for the Design of Cold-Formed Steel Structural Members.
      a. ANSI/SDI RD, Standard for Steel Roof Deck.

B. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
   1. AWS D1.1.
   2. AWS D1.3.

C. Installer Qualifications:
   1. All steel roof deck welders AWS certified for welding of sheet steel.
   2. All mechanical fasteners installers certified or licensed by fastener and tool system manufacture on project site in accordance with ANSI A10.3 requirements. Certification or licensing includes all training necessary for proper tool operation, fastener selection, maintenance and troubleshooting.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
   1. Do not rack, bend or mar steel roof deck sheets.

B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. If ground storage is needed, the deck bundles must be stored off the ground, with one end elevated to provide drainage. Bundles must be protected against condensation with a ventilated waterproof covering. Bundles must be stacked so there is no danger of tipping, sliding, rolling, shifting or material damage. Bundles must be periodically checked for tightness and retightened as necessary.
   2. Deck bundles placed on the building frame must be placed near a main supporting beam at a column or wall. In no case are the bundles to be placed on unbolted frames or an unattached and/or unbridged joist. The structural frame must be properly based to receive the bundles.

C. Store welding electrodes, mechanical fasteners and powder-actuated cartridges in original packages in a cool, dry location until final installation.

D. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Collect cut-offs and scrap and place in designated area for recycling in accordance with Waste Management Plan and local recycler standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products of deck manufacturers certified by Steel Deck Institute will be considered, providing their products equal or exceed quality specified; and they can provide products of type, size, function, and arrangement as indicated.
   1. Units shall be capable of supporting design loads shown.

B. In other Part 2 articles where titles below introduce lists, following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide product by manufacturers specified.

C. Products of other manufacturers will be considered for acceptance provided they equal or exceed material requirements and functional qualities of specified product. “Substitution Request Form” and complete technical data for evaluation must accompany request for A/E’s approval. All materials for evaluation must be received by Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Design Requirements
   1. Compute properties of metal roof deck sections on basis of effective design width as limited by provisions of SDI specifications. Provide deck section properties, including section modulus and moment of inertia per foot of width.
   2. Allowable Deflection: Design and fabricate deck for a maximum deflection of 1/240 of clear span under uniform live load.
   3. The deck shall be selected to provide the load capacities shown on drawings and as determined using the ANSI/SD RD construct loading criteria.
   4. The deck type provided shall be capable of supporting the superimposed live loads as shown on the plans.

B. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for Design of Cold-Formed Steel Structural Members."

C. Low-Emitting Materials: Paint and coatings shall comply with testing and product requirements of California Department of Health Services' "Standard Practice for Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI RD" and with following:
   1. Galvanized Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33 G60 zinc coating, unless otherwise noted.
      a. Do not pre-treat surface with chromates or other passivating treatments where deck is to be painted.
      b. Prime-painted deck is not acceptable.
   2. Deck Profile: Type WR, wide rib, unless otherwise noted.
      a. Provide Type N, deep 116, where indicated.
   3. Profile Depth: 1-1/2 inches, unless otherwise noted.
      a. Provide Type N, 3-inch-deep rib, where indicated.
   4. Design Uncoated-Steel Thickness: As indicated.
   5. Span Condition: Triple span or more, unless otherwise noted.
   6. Side Laps: Overlapped or interlocking seam at Contractor’s option.
   7. Ridge and valley plates, flat plates at changes of deck direction, sump pans, and side closures shall be the standard type provided by the deck manufacturer, unless indicated otherwise on the drawings.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
   1. Products:
      a. X-ENP-19 L15 or X-HSN-24 pins, Hilti.
      b. TEKS, ITW Builders.
      c. D100; MKT Fastening, LLC.
   2. Design Requirements: ICC-ES AC43 or SDI method for diaphragm shear strength and stiffness.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
   1. Design Requirements: ICC-ES AC43 or SDI method for diaphragm shear strength and stiffness.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

F. Galvanizing Repair Paint: ASTM A 780 or SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Layout: Place steel roof deck sheets ensuring bearing on supporting steel framing. Sheets shall be true and straight with horizontal deviations less than ¼ inch in 100 feet. Minimum end laps 2 inches.

C. Marking: Mark steel roof deck at centerline of supporting steel members to prevent weld burn through or mechanical fastener punch trough. Use a chalk line or indelible marker.

D. Test Fastenings:
   1. Welds: Perform project specific test welds prior to final installation per AWS D1.3. Test welds are considered examples or representative work.
   2. Mechanical fasteners: gauge powder-activated tool systems to base material steel type, steel deck type and thickness prior to final installation. Confirm appropriate power regulation and powder-activated cartridge type prior to final installation.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks. Attach firmly to the supports immediately after placement in and or to form a safe working platform.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
   1. Trades that subsequently cut unscheduled openings through the deck are responsible for reinforcing the openings.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as indicated.
   1. Weld Diameter: 5/8-inch, minimum.
   2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches apart in field of roof and 6 inches apart in roof corners and perimeter, based on roof area definitions in FMG Loss Prevention Data Sheet 1-28, unless otherwise indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, as indicated.
   1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws or fasten with a minimum of 1-1/2-inch-long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
   1. End Joints: Lapped 2 inches minimum, unless otherwise noted.
      a. End joints of 3-inch roof deck may be butted over center of supports.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
   1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

E. Support of Other Work: Suspension wires, straps, chains, and metal framing such as those used to support following shall not be attached to or through steel roof decks.
   1. Bulkheads.
   2. Suspended ceilings.
   3. Fire-suppression systems.
   4. Ductwork.
   5. Lighting.
   6. Similar items.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SID QA/AC.
      a. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and A/E.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.
   1. Before placement of roof insulation and roof covering, the deck shall be inspected for tear, dents or other damage that may prevent the deck from acting as a structural roof base. The need for repair of damaged deck shall be determined by the A/E based on structural performance.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair of Blow Holes in Deck: All holes require sheet metal plate patches fastened to deck in accordance with SDI Deck Damage and Penetrations.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.
   1. Do not use deck units as a working platform or storage area until units are in position and permanently attached to the structure.

2. Construction loads must not exceed load carrying capacity of the deck.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Non-axial load-bearing
      a. Exterior non-load-bearing wall framing.
      b. Interior non-load-bearing wall framing, where indicated.
   2. Soffit framing.

B. Related Sections include the following:
   1. Division 04 Section “Unit Masonry” for coordination with anchors.
   2. Division 05 Section "Metal Fabrications".
   3. Division 06 Section “Sheathing” for sheathing.
   4. Division 07 Section “Boardstock Air Barrier” for coordination.
   5. Division 09 Section "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.2 PREINSTALLATION MEETING

A. Preinstallation Meeting: Conduct meeting at Project site.
   1. Review and Discuss: Project requirements, substrate conditions, and manufacturer’s installation instructions.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings:
   1. Provide Shop Drawings prepared by cold-formed steel framing manufacturer.
   2. Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   3. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.
   1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Shop drawings must be prepared by manufacturer before issued to A/E.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
   1. Steel sheet
   2. Expansion anchors
   3. Mechanical fasteners
   4. Vertical deflection clips
   5. Horizontal drift deflection clips
   6. Miscellaneous structural clips and accessories.

C. Research Reports:

1. For cold-formed steel framing from a qualified testing agency acceptable to authorities having jurisdiction.
2. Steel framing manufacturer to have a third-party evaluation report for its products that are reviewed to the codes indicated on drawings and AISI S100.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of shop drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Manufacturer
1. Product Tests: Mill certificates or data from a qualified independent testing agency or in-house testing with calibrated test equipment per ICC AC46 Acceptance Criteria for Cold-Formed Steel Framing Members indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
2. Provide full time quality control over fabrication and erection complying with applicable codes, ordinances, rules and regulations of government agencies having jurisdiction.

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
1. Quality welding processes and welding operations in accordance with AWS “Standard Qualification Procedure”.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect and store cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling, per requirements of AISI’s “Code of Standard Practice”.
1. Store materials protected from exposure to rain, snow, and other harmful weather conditions, at temperature and humidity conditions per AISI S202.

B. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
1. Collect cut-offs and scrap and place in designated area for recycling in accordance with the Waste Management Plan and local recycler standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
1. Clark Dietrich
2. SCAFCO Steel Stud Company
3. MarinoWARE
4. MBA Building Supplies
5. Telling Industries
6. The Steel Network
7. All Steel and Gypsum Products, Inc.
8. MRI Steel Framing, LLC
9. Jaimes Industries
10. State Building Products

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany request for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design cold-formed metal framing.

B. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design steel in accordance with AISI S100, current addition, and AISI S240 unless otherwise noted.
   2. Design Loads: As indicated.
   3. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height, unless otherwise noted.
         1) Provide a horizontal deflection of 1/600 of the wall height when supporting masonry.
      b. Soffit Framing: Vertical deflection of 1/360 of the span.
   4. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
   5. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement of 1 inch.

C. Cold-Formed Steel Framing, General: Design according to AISI's S100 and AISI S240.
   1. Headers: Design according to AISI's S212 "Standard for Cold-Formed Steel Framing - Header Design."
   2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

D. Cold-Formed Steel Framing Design Standards: AISI S240.

2.3 MATERIALS

A. Framing Members, General: Comply with AISI S240 for conditions indicated.

B. Steel Sheet: ASTM A 1003, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: As required by structural performance.
   2. Coating: CP 60: G60 (Z180), A60 (ZF180), AZ50 (AZM150), or GF30 (ZGF90) minimum.
      a. CP90: G90, AZ50, or GF45 where framing backs up masonry.

C. System Components, General: With each type of metal framing required, provide manufacturer’s standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories as recommended by manufacturer for applications indicated, as needed to provide complete metal framing system.
   1. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653, structural steel, zinc coated, of grade and coating as follows:
      a. Grade: As required by structural performance.

b. Coating: CP 60: G60 (Z180), A60 (ZF180), AZ50 (AZM 150), or GF30 (ZGF90) per AISI S240, unless otherwise noted.
1) CP90: G890, AZ50, or GF45 where framing backs up masonry.

D. Stud Punch-Outs: Minimum 10 inches between end of member and near edge of web punch-out and 24 inches on center thereafter.

2.4 EXTERIOR AND INTERIOR NON-LOAD-BEARING WALL FRAMING (NON-AXIAL)

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base- Steel Thickness: 0.0428 inch (fka 18 gauge).
2. Minimum Flange Width: 1-5/8 inches .

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base- Steel Thickness: 0.0428 inch (fka 18 gauge).
2. Minimum Flange Width: 1-1/4 inches.

C. Deflection Track (Slotted): Manufacturer’s single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure.
1. Basis-of-Design: ClarkDietrich; MaxTrak Slotted Deflection Track or comparable product by other listed manufacturers.
2. Leg Dimension: 3 inches with 2-inch slot.

D. Steel Box or Back-to-Back Headers: Manufacturer’s one-piece members, or standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and with minimum base steel thickness, flange width and section properties required to meet design requirements.

E. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
1. Basis-of-Design: ClarkDietrich; FastClip Slide Clip or Fixed Universal Slip Chip (FUS) or compatible product by other listed manufacturers.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.
1. Basis-of-Design: ClarkDietrich; Drift FastClip Slide Clip (D-FCSC) or Drift Head-of-Wall Clip (DHOW) or comparable product by other listed manufacturers.
2. Minimum Base Steel Thickness: 0.0677 inch.

2.5 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections of web depths as required to meet load requirements including uplift, with stiffened flanges, and as follows:
1. Minimum Base- Steel Thickness: 0.0428 inch (fka 18 gauge).
~~2.~~ Minimum Flange Width: 1-5/8 inches.

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, structural grade, Type H, metallic coated, of same grade and coating weight used for framing members, complying with AISI S240.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153, Class C.

C. Post-Installed Anchors: Refer to Division 05 Section “Metal Fabrications” for post-installed anchor requirements.

D. Power-Actuated Anchors: fastener systems with working capacity greater than of equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
   1. Powder-actuated pins are not acceptable.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20, MIL-P-21035B, or ASTM A 780.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multi-monomer plastic, non-leaching.

E. Sill Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

F. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type 1 (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

G. Minimum 20-gauge 6-inch strap to secure the flashing termination bar.

2.9 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed metal framing members by welding or screw fastening as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

1. Basis-of-Design Product: ClarkDietrich; Panel Lift Clip (PLC) or comparable products by one of the listed manufacturers.

C. Fabrication Tolerances: Fabricate assemblies' level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

B. Install sill sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud ~~or joist~~ locations.

C. Do not install any materials with signs of "red rust". It is progressive and will continue to spread. "White rust is okay. It is considered a wet storage stain and is not progressive. It is just the zinc coating reacting to moisture.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to ASTM C1007, AISI's S240 "Standard for Cold-Formed Steel Structural Framing", AISI S202," and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

2. Do not weld or mechanically fasten to or through steel roof deck.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR AND INTERIOR NON-LOAD-BEARING WALL INSTALLATION (NON-AXIAL)

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track, unless otherwise indicated. Space studs as follows:
1. Maximum Stud Spacing: 16 inches

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to bypassing and infill studs and anchor to building structure.
3. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection. Provide one of the following:
1. Channel Bridging: Cold-rolled steel channel welded or mechanically fastened to webs of punched studs.
2. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
3. Install solid blocking at 96-inch centers.

4. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
5. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.
1. Uplift Bracing: Place metal framing between the runners and the structure above at 4-foot o.c. in each direction. Design framing for a maximum deflection of 1/360 of its height under the dead load plus a wind force of 30 psf, minimum acting in either direction.
a. Provide uplift bracing at all exterior ceilings and soffits.

3.5 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.6 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and A/E.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. General: The extent of metal fabrications includes items fabricated from iron and steel shapes, plates, bars, strips, tubes, pipes, and castings which are not a part of structural steel systems in these Specifications.
   2. Steel framing and supports for overhead sectional doors.
   3. Steel framing and supports for mechanical and electrical equipment.
   4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   5. Post-installed, torque-controlled expansion anchors.
   6. Adhesive anchor bolts.

B. Products furnished, but not installed, under this Section include the following:
   1. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
   2. Loose steel lintels.

C. Related Sections include the following:
   1. Division 04 Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items indicated to be built into unit masonry.
   2. Division 05 Section "Structural Steel Framing" for lintels and loose bearing and leveling plates.

1.2 COORDINATION

A. Coordinate installation of anchorages for metal fabrications or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Adhesive anchor bolts.
   2. Post-installed, torque-controlled expansion anchors.
   3. Paint products.
   4. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
      a. Steel framing and supports for overhead sectional doors.
      b. Steel framing and supports for mechanical and electrical equipment.
      c. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   2. Provide templates for anchors and bolts specified for installation under other Sections.

C. Sample for Initial Selection: For each finish specified, provide two complete sets of color chips representing manufacturer's full range of available colors.

D. Performance Requirement Verification: Provide verification that installation of products will result in compliance with "Performance Requirements" indicated. This may include calculations, testing results, manufacturer installation, and attachment requirements, fastener information for indicated substrate, or other means necessary to demonstrate compliance.

1.4 QUALITY ASSURANCE

A. Qualifications:
1. Structural fasteners shall be manufactured in the United States. Fabricator shall furnish proof of U.S. manufacturer. If it becomes necessary to use imported fasteners, each size, type, and each large quantity package (500 pcs. or more) shall undergo a random sampling of a minimum 5 pieces for testing. Test results are to be provided to A/E. Test shall be performed by an independent testing agency, and the cost shall be included in the Base Bid. If inferior fasteners are discovered, all fasteners of that type shall be removed and replaced with acceptable fasteners at no cost to the Owner. If possible, fasteners shall be tested prior to use in construction.

B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."

C. Post-Installed Torque-Controlled expansion Anchors and Adhesive Anchor Bolts: Installers of post-installed anchors shall undergo a manufacturer's training program or be provided with on-site instruction for proper installation from a manufacturer's representative.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Waste Management and Disposal; As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
1. Collect cut-offs and scrap and place in designated area for recycling in accordance with the Waste Management Plan and local recycler standards.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.

3. Basis-of-Design Product: The design for each product type is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany request for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.4 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Steel Tubing: ASTM A 500, cold-formed steel tubing.

C. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

D. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-4.
1. Size of Channels: 1-5/8 inch wide single and double channels as required.
2. Material: Steel complying with ASTM A 1008, structural steel, Grade 33; 0.0528-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.
   a. Galvanized steel complying with ASTM A 653, structural steel, Grade 33, with G90 coating; 0.079-inch nominal thickness, where indicated.
3. Fittings: Fabricate from steel that meets or exceeds the physical requirements of ASTM A1011 SS Grade 33 and conforms to one of the following ASTM specifications:
   a. A1011 SS Grade 33
   b. A575
   c. A576
   d. A36
   e. A635
   f. Fittings as required to create grid indicated on Drawings without grid being constructed as overlapping members. Fittings shall include but not be limited to in-channel joiners.
4. Supplemental Framing: Slotted channel framing, threaded rods, system connectors, beam clamps, and other connectors to structural steel as required to suspend system from the structural steel framing.

E. Cast Iron: Either gray iron ASTM A 48, or malleable iron, ASTM A 47, unless other indicated or required by structural loads.

2.5 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, or ASTM F 1941 Class Fe/Zn 5, at exterior walls.

B. High-Strength Bolts, Nuts, and Washers: ASTM F 3125, Grade A 325, Type 3, heavy-hex steel structural bolts; ASTM A 563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
   1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

F. Eyebolts: ASTM A 489.

G. Machine Screws: ASME B18.6.3.

H. Lag Bolts: ASME B18.2.1.

I. Wood Screws: Flat head, ASME B18.6.1.

J. Plain Washers: Round, ASME B18.22.1.

K. Lock Washers: Helical, spring type, ASME B18.21.1.

L. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
   1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM F 2329.

M. Post Installed, Torque-Controlled Expansion Anchors: Anchor bolt and sleeve assembly satisfying the cracked concrete requirements of ICC-ES AC 193 with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
   1. Products:
      a. Kwik Bolt TZ Concrete of Kwik Bolt 3 (Masonry); Hilti, Inc.
      b. Strong Bolt II; Simpson Strong-Tie Company, Inc.
      c. Powder-Stud +302 (Concrete) Power-Stud 301 (Masonry); Powers Fasteners
   2. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5 or ASTM F 1941, Class Fc/Zn5, unless otherwise indicated. .
   3. Material for Anchors in Exterior Locations: Alloy Group 1 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

N. Adhesive (Chemical) Anchor Bolts (In Concrete): Chemically grouted adhesive (chemical) anchor bolts satisfying the cracked concrete requirements of ICC-ES AC 308. Subject to compliance with requirements, provide one of the following:
   1. Products:

a. HY 200 Safe Set system or RE 500 V3 Safe Set; Hilti, Inc.
b. Powers PE 1000+; Powers Fasteners
c. Epcon G5, ITW Rod Head
d. Simpson Set Epoxy-Tie Adhesive Anchors; Simpson Strong-Tie Company, Inc.

2. Anchors to be ASTM A36 or A307, zinc plated steel threaded rods (Fy = 36 ksi) unless otherwise noted.
3. Where noted on the drawings anchors to be ASTM F593, Condition CW stainless steel threaded rods (Fy = 65 ksi for diameters 3/8 inch through 5/8 inch and Fy = 45 ksi for diameters 3/4 inch through 1-1/4 inch).
4. Anchors to be installed in strict conformance to manufacturer's installation instructions.
5. Adhesive Anchors shall have the following minimum allowable load capacities: (Based on embedment in 4000 psi concrete and a minimum safety factor on ultimate load capacities of 3.5. Use proportional allowable loads for other strengths of concrete. Note: Actual anchor load capacity varies with spacing and edge distance.)

Size	Allowable Shear	Allowable Tension	Minimum Embedment
3/8 inch	1000 lbs.	2100 lbs.	3-3/8 inch
1/2 inch	1850 lbs.	3300 lbs.	4-1/4 inch
5/8 inch	2900 lbs.	5100 lbs.	5 inches
3/4 inch	4200 lbs.	6800 lbs.	6-5/8 inch
1 inch	7500 lbs.	11,000 lbs.	8-1/4 inch

O. Adhesive Anchor Bolts (In Masonry)
1. In hollow CMU: Chemically grouted adhesive anchor systems with nylon or stainless steel screen inserts.
a. Products:
1) HIT HY270 Adhesive Anchors, Hilti, Inc.
2) AC100+ Gold; Powers Fasteners
3) Simpson Set Epoxy-Tie Adhesive Anchors, "AT-HP" Simpson Strong-Tie Company, Inc.
2. In solid grouted CMU: Chemically grouted adhesive anchor systems. If voids in grout are encountered, use adhesive anchor bolts specified above for hollow CMU.
a. Products:
1) HIT-ICE (Cold Weather) or HY270 (Hot Weather) Adhesive Anchors, Hilti, Inc.
2) AC100+ Gold; Powers Fasteners
3) Simpson Set Epoxy-Tie Adhesive Anchors, "AT-XP" Simpson Strong-Tie Company, Inc.
3. Anchors to be ASTM A36 or A307 zinc plated steel threaded rods (Fy = 36 ksi) unless otherwise noted.
4. Where noted on the drawings, anchors to be ASTM F593, Condition CW stainless steel threaded rods (Fy = 65 ksi for diameters 3/8 inch through 5/8 inch and Fy = 45 ksi for diameters 3/4 inch through 1-1/4 inch).
5. Anchors to be installed in strict conformance to manufacturer's installation instructions.
6. Adhesive anchors shall have the following minimum allowable load capacities: (Based on F'm = 1500 psi , grout with f'c = 2500 psi at 28 days and a minimum safety factor on ultimate load capacities of 3.5. Note: Actual anchor load capacity varies with spacing and edge distance.)

a. In Hollow CMU:

Size	Allowable Shear	Allowable Tension	Minimum Embedment
3/8 inch	600 lbs.	500 lbs.	2 inch
1/2 inch	900 lbs.	500 lbs.	2 inch

b. In Solid Grouted CMU:

Size	Allowable Shear	Allowable Tension	Minimum Embedment
1/2 inch	1200 lbs.	1400 lbs.	4-1/4 inch
5/8 inch	1600 lbs.	1800 lbs.	5 inch

3/4 inch	1600 lbs.	2900 lbs.	6-5/8 inch

7. Adhesive anchor bolt suppliers shall submit product data, including certified test results showing the ultimate and allowable shear and tension load capacities for all anchors sizes and types to be furnished.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Primers: Provide primers that comply with Division 09 painting Sections, where metal fabrication will be painted in field.

D. Universal Shop Primer, unless otherwise noted: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187 or SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert type noncorrosive compound free of asbestos fibers, sulfur compounds, and other deleterious impurities.

2.7 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

H. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.8 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts if units are installed after concrete is placed.

2.9 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
1. ASTM A 123, for galvanizing steel and iron products.
2. ASTM A 153, for galvanizing steel and iron hardware.
3. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items, not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
1. Shop prime with universal shop primer, unless otherwise indicated.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
1. Exterior Items: SSPC-SP 6/NACE No. 3, “Commercial Blast Cleaning”.
2. Other Steel Items: SSPC-SP3, “Power Tool Cleaning”.
3. Galvanized-Steel Items: SSPC-SP16, “Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals”.

D. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Paint items embedded in concrete with two coats of bituminous paint.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installer shall examine areas and conditions under which miscellaneous metal items shall be installed. Notify Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.2 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Coat concealed surfaces of steel embedded in concrete with two coats of bituminous paint.

3.4 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for overhead doors securely to and rigidly braced from building structure and in accordance with ASTM E 557.

END OF SECTION 05 50 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Steel pipe and tube railings.

B. Mark furnished but installed under other Sections:
   1. Furnish sleeves and anchors to be cast in concrete to Division 03 Section “Cast-in-Place Concrete”.

C. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for additional requirements for chemical anchors.
   2. Division 09 painting sections for:
      a. Shop primer.
      b. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint.

1.2 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer's product lines of mechanically connected railings.
   2. Grout, anchoring cement, and paint products.

B. Shop Drawings: For all railing systems, including:
   1. Splices and attachments.
   2. Identify location of all railing systems.
   3. Indicate railing systems in related and dimensional position, with elevations at scale of 1/4 inch equals 12 inches and details at scale of 3 inch equals 12 inch (1:5) or larger.
   4. Show all details and dimensions not governed by field conditions.
   5. Indicate all required field measurements.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Welding certificates.

B. Qualification Data: For professional engineer.

C. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."

B. Engineer Qualifications: Professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated for handrails and railing systems similar to this Project in material, design, and extent, and that have a record of successful in-service performance.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
   2. Provide allowance for trimming and fitting at site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.

C. Storage on Site
   1. Store material in a location and in a manner to avoid damage. Stacking shall be done in a way which will prevent bending.
   2. Store aluminum, bronze, and stainless steel components and materials in a clean, dry location, away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin or polyethylene sheeting in a manner that will permit circulation of air inside the covering.

D. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of materials.
   1. Refer to NAAMM Manual AMP 555-92, Code of Standard Practice for the Architectural Metal Industry, Sections 6 and 7.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for Architect/Engineer’s approval must be accompanied by the “Substitution Request Form” and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, posts, and attachments to adjoining construction, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings and posts to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   1. Steel: 72 percent of minimum yield strength.

C. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.

D. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.
   1. Provide bracket that provides [1-1/2 inch][2-1/4 inch] clearance from inside face of handrail to finished wall surface.

2.4 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

B. Pipe: ASTM A 53, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
   1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36.

2.5 FASTENERS

A. General: Provide the following:
   1. Hot-Dip Galvanized Railings: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153 or ASTM F2329 for zinc coating.
   2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

D. Post-Installed Anchors: Provide chemical, anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
   1. Refer to Division 05 Section "Metal Fabrications."

E. Brackets, Flanges, Fittings and Anchors: Provide flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of handrails and guards to other work. Furnish inserts and other anchorage devices for connecting handrails and guards to concrete work.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
   1. Water-Resistant Product: Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
   1. Clearly mark units for reassembly and coordinated installation.
   2. Use connections that maintain structural value of joined pieces equally spaced per code requirements between top rail and finish floor or nosing line of tread.
   3. Locate intermediate rails.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water or condensation may accumulate.
   1. Weeps should be set such that the post base does not hold water. A pourable sealer can be used within the post to fill the hollow portion of the post up to the level of the weep or provide condensation sleeves or diverters.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or nonwelded connections, unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

a. Do not weld aluminum.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. Weld exposed corners and seams continuously, unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds; completely sanded joint, some undercutting and pinholes okay.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form changes in direction as follows:
1. By bending or by inserting prefabricated elbow fittings.

K. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings or by welding metal closure in place.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
2. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with steel plate forming bottom closure.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:
1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
2. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
3. Comply with ASTM A 123 for hot-dip galvanized railings.
4. Comply with ASTM A 153 for hot-dip galvanized hardware.
5. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
6. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, direct, oil, flux, and other foreign matter, and treat with etching cleaner.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings.
   1. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
   2. Fit exposed connections together to form tight, hairline joints.
   3. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
   4. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
   5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
   6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches of post.
   1. Steel: Provide expansion joints on straight runs exceeding 40 feet.

3.3 ANCHORING POSTS

A. Tolerance: Set posts plumb and aligned to within 1/4 inch in 12 feet.

B. Setting Posts, General:
   1. Clean dust and foreign matter from sleeves/holes.
   2. Moisten interior of holes and surrounding surfaces with clean water.
   3. Prepare and use grout in accordance with manufacturer’s directions.
   4. Place posts in position and brace until grout sets.
   5. Pour mixture into annular space until it overflows the hole.
   6. Wipe off excess and leave 1/8 inch build-up sloped away from post.

C. Use steel pipe sleeves preset and anchored into concrete for installing posts. Make hole diameter at least 3/4 inch larger than O.D. of post. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
   1. Exterior Locations: Use anchoring cement.

D. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch buildup, sloped away from post.

3.4 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.5 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 52 13

06 CARPENTRY

DIVISION

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Rooftop equipment bases and support curbs.
   2. Wood blocking and nailers.
   3. Interior wood trim, i.e. baseboard as needed to accommodate new work.
   4. Miscellaneous plywood panels.

B. Related Sections include the following:
   1. Division 06 Section "Sheathing" for sheathing.
   2. Division 07 Section “Roof Restoration” for roof work.
   3. Division 07 Section "Boardstock Air Barrier” for coordination with blocking (opening framing).

1.2 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NeLMA: Northeastern Lumber Manufacturers' Association.
   2. NHLA: National Hardwood Lumber Association.
   3. NLGA: National Lumber Grades Authority.
   4. SPIB: The Southern Pine Inspection Bureau.
   5. WCLIB: West Coast Lumber Inspection Bureau.
   6. WWPA: Western Wood Products Association.

1.3 PREINSTALLATION MEETING

A. Pre-Installation Meeting: Conduct meeting at Project site, unless otherwise noted. Attendees shall include installers whose work requires in-wall blocking.
   1. Review in-wall blocking for attachment and opening framing.
   2. Distribute information on items furnished Owner and installed by the Contractor.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Indicate type of preservative used and net amount of preservative retained.
      a. Indicate compliance with AWPA requirements.
      b. Indicate products contain no arsenic or chromium.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

B. Composite wood products shall be labeled or show compliance with the Toxic Substances Control Act (TSCA) Title VI.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

C. Waste Management: As specified in Division 01 Section – "Construction Waste Management and Disposal" and as follows:
   1. Select lumber sizes to minimize waste, reuse scrap lumber to greatest extent possible. Clearly separate scrap lumber for use on-site as accessory components, including shims, bracing, and blocking.
   2. Separate wood waste in accordance with the Waste Management Plan and place in designated areas in the following categories for recycling:
      a. Solid wood; softwood or hardwood.
      b. Composite wood.
      c. Treated, painted or contaminated wood.
         1) Do not burn scrap lumber that has been pressure treated.
         2) Do not send lumber treated with pentachlorophenol to cogeneration facilities or “waste-to-energy” facilities.
   3. Prevent saw dust and wood shavings from entering the storm drainage system.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS (WPTM)

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:
   1. Wood curbs, equipment support bases, and similar members exposed to weather in connection with roofing.

2.3 FIRE-RETARDANT-TREATED MATERIALS (FRTM)

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
   1. Use treatment that does not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
   3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
   4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841

C. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

D. Application: Treat items indicated on Drawings, and the following:
   1. All concealed blocking.
   2. Opening blocking where boardstock air barrier is used.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Rooftop equipment bases and support curbs.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 15 percent maximum moisture content of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
   1. Mixed southern pine, No. 2 grade; SPIB.
   2. Hem-fir or hem-fir (north), Construction or 2 Common grade; NLGA, WCLIB, or WWPA.
   3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
   1. Provide No. 2 grade Douglas Fir or Southern Yellow Pine nailers associated with roofing and roof flashing.

2.5 INTERIOR WOOD TRIM

A. General: Provide kiln-dried finished (surfaced) material without finger-jointing, unless otherwise indicated.

B. Hardwood Lumber Trim for Transparent (Stain or Clear) Finish: Clear red oak.

C. Hardwood Lumber for Transparent (Stain or Clear) Finish: Grade A Finish red oak, NHLA, unless otherwise noted or required to match existing.

2.6 MISCELLANEOUS PLYWOOD PANELS

A. General: Where plywood panels will be used for the following concealed types of applications, provide APA performance rated panels complying with requirements indicated for grade designation, span rating, exposure durability classification, edge detail (where applicable), and thickness.

B. Plywood Shims, Nailers, and Blocking for Roof Insulation Stops: Shall be APA UNDERLAYMENT C-C PLUGGED EXT.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153 or Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
   1. ASTM C 1002 may be used for non-load-bearing steel framing 20 gauge or less.

F. Lag Bolts: ASME B18.2.1.

G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

I. Post-Installed Anchors: Refer to Division 05 Section “Metal Fabrications”.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
1. Provide opening framing, where indicated and boardstock air barrier is used.

D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WOOD TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.
1. Match color and grain pattern across joints.
2. Install trim after gypsum board joint-finishing operations are completed.
3. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads and fill holes.
4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 53

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Wall/Roof sheathing.
   2. Sheathing joint-and-penetration treatment, option.

B. Related Sections include the following:
   1. Division 05 Section “Cold-Formed Metal Framing” for coordination.
   2. Division 06 Section “Miscellaneous Rough Carpentry" for miscellaneous plywood panels.
   3. Division 07 Section "Thermal Insulation" for coordination and miscellaneous insulation.
   4. Division 07 Section “Weather Barriers” for coordination.
   5. Division 07 Section “Boardstock Air Barrier”.
   6. Division 07 Roofing Sections for coordination of parapet insulation provided as part of roofing.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Meeting: Schedule before start of each major segment or wall construction area. Be aware of all contract work that interfaces with wall assemblies as they are being erected. Contractor shall participate in various trade preconstruction meetings that interface with exterior wall assemblies. Educate and advise all workers concerning protection and cutting and patching procedures.
   1. Attendance: All trades whose work interfaces with wall assemblies.
   2. Verify all openings and penetrating items, pipe, ducts, conduits, and the like and ensure sleeves are properly sized and located and capable of being secured.
   3. Review transitions, special penetrations details, proposed openings, structural elements, and conditions of the other construction that will affect wall assembly.
   4. Review temporary protection requirements.

B. Pre-Installation Meeting; Convene prior to commencing work of this Section. Review installation procedures and coordination required with “Related Work” and the following:
   1. Participants: Authorized representatives of the Contractor, A/E, installer, and manufacturer.
   2. Review wall assemblies for potential interference and conflicts and coordinate layout and support provisions for interfacing work.
   3. Review continuous insulation wall panels installation methods and procedures related to application, including manufacturers, installation guidelines.
   4. Review firestopping requirements and weather barrier requirements and placement locations.
   5. Review field quality control procedures.

C. Sequencing
   1. Coordinate with installation of weather barrier.
   2. Ensure that products of this Section are supplied to affected trades in time to prevent interruption of construction progress.
   3. Do not install products under environmental conditions outside manufacturer’s absolute limits.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Wall Sheathing Product Test Reports: Submit evaluation reports published by independent laboratory indicating evidence of compliance with specified criteria.
1. NFPA 285 Compliance: Submit documentation showing components in wall assembly are in compliance with NFPA 285.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications:
1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs, inspections to verify that the material bearing the classification marking is representative of the material tested.

B. Mockups: Build mockups to set quality standards for materials and execution.
1. First-in-place 150 sq.ft. of exterior wall assembly incorporating backup wall construction, window, storefront, door frame and sill, ties and other penetrations, and flashing to demonstrate crack and joint treatment and sealing of gaps, terminations, and penetrations shall serve as mockup.
a. Include junction with roof membrane, building corner condition, and foundation wall intersection, if applicable.
b. If A/E determines mockups do not comply with requirements, reconstruct mockups until mockups are approved.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless A/E specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings. Protect sheathing from weather by covering with waterproof sheeting, securely anchored.

B. Store composite nail board sheathing products off the ground, in dry conditions, under cover and in manufacturer's unopened packaging until ready for installation.
1. The manufacturer's plastic wrapping is provided for protection during shipment only. Replace any panels that become wet before installation.
2. Insulation shall rest on firm blocking minimum of 2 inches above ground and shall be covered with waterproof tarps.

C. Waste Management: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
1. Select lumber sizes to minimize waste, reuse scrap lumber to greatest extent possible. Clearly separate scrap lumber for use on-site as accessory components, including shims, bracing, and blocking.

2. Separate wood waste in accordance with the Waste Management Plan and place in designated areas in the following categories for recycling:
    a. Solid wood; softwood or hardwood.
    b. Composite wood.
    c. Treated, painted or contaminated wood.
        1) Do not burn scrap lumber that has been pressure treated.
        2) Do not send lumber treated with pentachlorophenol to cogeneration facilities or "waste-to-energy" facilities.
3. Prevent saw dust and wood shavings from entering the storm drainage system.

D. Composite wood products shall be labeled or show compliance with the Toxic Substances Control Act (TSCA) Title VI.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide product by the manufacturers specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Fire Resistance: Exterior wall system and component materials part of cold-formed metal framing assembly shall comply with the following requirements:
1. System complies with one of the following: NFPA 285, FM 4800, UL 1040, or UL 1715; Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-Load Bearing Wall Assemblies Containing Combustible Components using the Intermediate Scale, Multi-Story Test Apparatus.
2. Firestopping measures, per requirements of authorities with jurisdiction, shall be included at the floor line in the cold-formed stud cavity when the wall assembly extends beyond the floor line.

2.3 WOOD PANEL PRODUCTS, GENERAL

A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
1. Plywood.

C. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.

D. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

E. Factory mark panels to indicate compliance with applicable standard.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

C. Kiln-dry material after treatment to maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood indicated on Drawings, and the following:
1. Roof/wall sheathing (part of assembly), i.e. parapet at rated wall.

2.5 WALL SHEATHING

A. Plywood Wall/Parapet Sheathing: Exposure 1, Structural I sheathing (CDX).
1. Span Rating: Not less than 24/0.
2. Nominal Thickness: Not less than 5/8 inch.

B. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed; Saint-Gobain
   b. Continental Building Products, LLC
   c. Georgia-Pacific Gypsum LLC
   d. National Gypsum Company
   e. USG Corporation
2. Type and Thickness: Regular, 1/2 inch thick, unless otherwise noted. Provide Type X, 5/8 inch thick, where required for thermal rating.

C. Foil-Faced, Polyisocyanurate-Foam Wall Sheathing (Where boardstock air barrier is not indicated or required): ASTM C 1289, Type I or Type II, Class 2, rigid, cellular, polyisocyanurate thermal insulation. Foam-plastic core and facings shall have a flame-spread index of 25 or less when tested individually.
1. Manufacturers:
   a. Hunter Panels
   b. Atlas Roofing Corp.
   c. Carlisle Coatings and Waterproofing Inc.
   d. DuPont
   e. Remax, Inc.

2. Thickness: As indicated
3. Thermal Resistance R-Value: 6.5 per inch.
4. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285, where required.

2.6 ROOF/PARAPET/SOFFIT SHEATHING

A. General: Unless otherwise noted provide one of the following:
1. Plywood Roof Sheathing: Exterior, Structural I sheathing.
a. Span Rating: Not less than 32/16.
b. Nominal Thickness: Not less than 5/8 inch, unless otherwise noted.
2. Glass-Mat Gypsum Parapet Sheathing: ASTM C1177.
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) CertainTeed; Stain-Gobain
2) Georgia-Pacific Gypsum LLC
3) National Gypsum Company
4) USG Corporation
b. Type and Thickness: Type X, 5/8 inch thick.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
1. For parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153 or Type 304 stainless steel.
2. Composite nailable insulated sheathing fasteners shall be approved by panel manufacturer. Fasteners are a corrosion resistant type with oversized heads. Length of fasteners shall be as recommended by the panel manufacturer.
a. Engineering Evaluations for fastening patterns (DrJ 1202-01 or DrJ TER 1508-01).

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Wood Structural Panels and Plywood-Surfaced, Polyisocyanurate-Foam Sheathing to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
1. For steel framing less than 0.0329 inch thick, attach sheathing to comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch thick, attach sheathing to comply with ASTM C 954.

2.8 INSULATED WALL SHEATHING ACCESSORIES

A. Liquid Spray Flashing: Provide insulation manufactured recommended board joint commercial liquid spray flashing and sealant for sealing joints, seams, window openings, door openings, counterflashing and penetrations through the insulation layers.
1. Meets ASTM 331 water penetration of existing windows by uniform static air pressure differences, as part of an approved assembly with continuous foam insulation.

B. Flashing Tape: Provide insulation manufactured recommended tape for counterflashing and penetrations through the insulation layer.
   1. Meets ASTM D3330 standard test method for peel adhesion for pressure sensitive tape.
   2. Water vapor transmission less than 1 perm.
   3. Application Temperature: 30 degrees F to 120 degrees F.
   4. UV Resistance: 120 days.

C. Penetration Filler: Provide insulated sheathing manufacturer's recommended polyurethane foam for sealing penetrations of insulated sheathing.
   1. Meets ASTM E84 standard test method for surface burning characteristics of building materials.
   2. Meets Modified ASTM E814 standard test method for fire block.
   3. Complies with Underwriters Laboratories, Inc. classification, as a sealant fire block.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and installation conditions for compliance with requirements for installation conditions affecting performance of the work.
   1. Verify that metal wall studs, opening framing, bridging, bracing, and other framing support members and anchorage have been installed within wall system alignment tolerances and requirements.
      a. Verify that all exterior wall assembly construction has been completed to the point where the sheathing may correctly be installed.
   2. Verify that items required to penetrate the wall system are placed and penetration gaps and cracks can be sealed to prevent water penetration.
   3. Verify that mechanical and electrical services in walls have been installed and tested and, if appropriate, verify that adjacent materials and finishes are dry and ready to receive sheathing.

B. Do not proceed with wall system installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION, GENERAL

A. General: Install in accordance with manufacturer's instructions.

B. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
   1. Install in exterior spaces without gaps or voids. Do not compress insulation.

C. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
   1. Fit tight in spaces and tight to exterior code of mechanical and electrical services within place of insulation.

D. Securely attach to substrate by fastening as indicated, complying with the following:
   1. ICC-ES ESR-1539 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."

E. Coordinate wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.
   1. Coordinate with installation of division 07 Section “Weather Barrier”.

3.4 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:
   1. Wall and Roof/Parapet Sheathing:
      a. Screw to cold-formed metal framing.
      b. Space panels 1/8 inch apart at edges and ends.

3.5 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
   2. Fasten gypsum sheathing to cold-formed metal framing with screws.
   3. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
   4. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.

C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
   1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

D. Seal sheathing joints according to sheathing manufacturer’s written instructions. Provide one of the following:
   1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
   2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.6 INSULATED WALL SHEATHING INSTALLATION

A. General: Install where Boardstock Air Barrier is not indicated or required.

B. Comply with manufacturer's written instructions. Fasten to exterior face of exterior face of exterior metal stud walls using sheathing manufacturer’s recommended type and length screw fasteners with washers. Abut panels tightly together and around openings and penetrations.
   1. Install in exterior spaces without gaps or voids. Do not compress insulation.
      a. Fill voids with spray foam insulation. Refer to Division 07 Section “Thermal Insulation”.
   2. Trim sheathing/insulation neatly to fit spaces.
   3. Coordinate with the cladding or mason for the attachment requirements over sheathing/insulation.

4. Exposed insulation must be protected from open flame and kept dry at all times.
5. Install sheathing panels horizontally with aluminum facing to exterior. Use maximum lengths to minimize number of joints. Locate edge joints parallel to and on framing. Center end joints over supports and stagger in each course. Provide additional framing wherever panel joints do not bear against framing plate or sill members.
6. Fasten panels to each support with fasteners spaced 12 inches on center at perimeter of the wall and 16 inches on center in panel field. Set back perimeter fasteners 3/8 inch from edges and ends of panel units. Drive fasteners to bear tight and flush with surface of insulation. Do not overdrive fastener causing damage to the insulation board facer. Perimeter fasteners can be detailed to bridge the gap of abutting board joints due to the 2 inch diameter of the washer used to fasten the board to studs. Maximum of two board joints may be bridged per fastener.
7. Install flashing at end and edge joints in accordance with sheathing manufacturer's joint sealing recommendations.
8. Seal sheathing joints and penetrations of sheathing in accordance with sheathing manufacturer's joint and penetration sealing recommendations.
9. After base flashing, which includes a termination bar running horizontally along the top edge of the flashing, is installed or exterior of insulated sheathing install either liquid spray flashing or flashing tape to the exterior sheathing and lapped over the top edge of the base. A flat strap must be included in framing at termination bar height to allow proper fastening of the termination bar.

C. Flashing and Sealant Installation
1. General: Apply spray in a well-ventilated area to ensure optimal product curing.
   a. Surface and ambient temperatures should be 35 degrees F and rising and below 120 degrees F during the application.
   b. Do not apply product on surface with standing water or frost.
2. Liquid spray flashing tolerates rain shortly after the curing process has begun (typically 1 to 4 hours); avoid installing on days with a high probability of significant rainfall.
3. Seal any gaps greater than 1/4 inch with insulating foam sealant or compatible sealant according to manufacturer's recommendations prior to applying liquid spray flashing. If facer on insulation board is damaged note the affected area so that additional spray can be applied appropriately. Damaged insulation can also be replaced or flashing tape can be used to tape down facer flaws.
4. Flash board joints, penetrations and other fenestration openings as required. Spray can be applied on one or two passes depending on site conditions.
5. Apply 3 inches, minimum over the board joints. Make sure that a minimum of 1 inch of spray covers each side of the joint. Fasteners and washers along the board joints should also be completely covered with liquid spray flashing.
6. For rough openings apply liquid spray flashing a minimum of 3 inches onto the sheathing face, completely covering the sheathing board edge. In turn extend spray a minimum of 3 inches back onto the rough opening substrate. It is recommended to cover a distance back onto the rough opening equal to what is covered by traditional flashing materials.
7. For penetrations through the rigid insulation or substrate apply the liquid spray flashing a minimum of 2 inches onto the sheathing face and a minimum of 2inches onto the penetration substrate or primary flashing substrate.
8. Use wet mil thickness gauge to ensure proper installation thickness. A paint brush can be used to even out product application thickness. If product is consistently below minimum thickness spray another pass to achieve proper thickness requirements.

D. Spray liquid flashing typically cures to touch within 1 to 4 hours after application. Depending on humidity, temperature, sun exposure, and wind direction this time can be longer. Application should be dry to an approximate 30 mil thickness when completely

3.7 PROTECTION

A. Protect installed products until finish materials can be applied.
1. Protect sheathing/insulation work from exposure to moisture damage and deterioration, primarily by prompt installation of the roofing, sheet metal and waterproofing work.

B. Cover the top and edges of unfinished roof panel work to protect it from the weather and to prevent accumulation of water in the cores of the panels.
   1. Do not leave panels exposed to moisture. Wet panels shall be removed prior to application of roof covering.

END OF SECTION 06 16 00

SECTION 06 41 16 – PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Plastic -laminate architectural (custom) cabinets.
   2. Plastic-laminate countertops.
   3. Cabinet hardware and accessories.
   4. Wood furring, blocking, shims, and hanging strips for installing architectural (custom) plastic-laminate-faced cabinets, unless concealed within other construction before cabinet installation.

B. Related Sections include the following:
   1. Division 02 Section “Selective Demolition” for removal of existing casework.
   2. Division 06 Section "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
   3. Division 07 Section “Joint Sealants”.
   4. Division 12 Section “Educational Casework” for modular casework.
      a. At a minimum, casework scheduled in the same rooms, spaces, and areas shall have coordinated:
         1) Plastic laminate selections.
         2) Working surface heights.
         3) Edge treatments.
         4) Backsplash/end splash conditions.
         5) Hardware finishes.
   5. Division 12 Section “Wood Countertops” for butcher block countertops.
   6. Division 22 Section “Plumbing Fixtures” for sinks.

C. Contractor Option: Unless otherwise noted, Contractor has option of providing either Division 06 Section “Plastic-Laminate-Faced Architectural Cabinets” or Division 12 “Manufactured Plastic-Laminate-Faced (Educational) Casework”. While a mixture complying with referenced standards is permitted, do not mix fabrication methods in individual room or spaces, unless specifically approved by A/E.

1.2 DEFINITIONS

A. General: Definitions in Architectural Woodwork Institutes (AWI) “Architectural Woodwork Quality Standards” apply to the work of this Section, unless otherwise noted herein.

B. MDF: medium-density fiberboard

C. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

D. Exposed Portions of Casework: Include surfaces visible when doors and drawers are closed. Bottoms of casework more than 4 feet above floor and tops less than 6 feet 6 inches above floor shall be considered as exposed. Visible members in open cases or behind glass doors also shall be considered as exposed portions. Any unit exterior side surface that is visible after installation.

E. Semi-Exposed Portions of Casework: Includes those members behind opaque doors, such as shelves, divisions, interior faces of ends, case back, drawer sides, backs and bottoms, and back face of doors. Tops of casework 6 feet 6 inches or more above floor shall be considered semi-exposed.

F. Concealed Portions of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination
1. Coordinate layout and installation of framing and reinforcements for support of casework.
a. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed and indicate measurements on Shop Drawings.
2. Coordinate casework installation with size, location, and installation of service utilities. Sequence installation to accommodate required utility connections.

B. Preinstallation Meeting(s):
1. Pre-installation Meeting: Conduct meeting at Project Site.
2. Keying Meeting: Conduct meeting at Project Site. Incorporate keying meeting decisions into final keying requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for electrical switches and outlets, plumbing fixtures, and other items installed in architectural woodwork.
3. Countertops; Include:
a. Plans, sections, details, edge, and backsplash profiles, and attachments to other work.
b. Locations and details of joints.
c. Locations and sizes of cutouts and holes for items installed in countertop.

C. Samples for Verification:
1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
2. Thermally Fused Laminate (TFL) Panels: 8 by 10 inches, for each color, pattern, and surface finish, with edge banding on one edge.
3. Exposed Cabinet Hardware and Accessories: One full-size for each type and finish.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Certification: Provide a letter from the particleboard manufacturer that product contains less than 1 percent asbestos by content.

B. Coordination Submittals:
1. Copy same materials to other trades and other Contractors who have connected or adjacent works for coordination review and for locating their work connected to or adjacent to the equipment specified herein.
2. Distribute review “Field Use” copies to all affected trades when casework manufacturer and affected Contractors have completed coordination necessary for complete installation.

C. Sustainable Design Submittals:
   1. Materials Ingredients: Provide the following:
      a. Documentation of chemical inventory through Health Product Declaration, Cradle to Cradle certification labels, manufacturer's list of ingredients with GreenScreen assessment reports for confidential ingredients or other USGBC approved programs (if applicable).
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   3. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

1.6 QUALITY ASSURANCE

A. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

B. Manufacturer's Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose product have a record of successful in-service performance.

C. Installer Qualifications: An authorized representative of casework manufacturer for installation and maintenance of units required for the project. References of these projects shall be supplied upon request.

D. Composite wood products shall be labeled or show compliance with the Toxic Substances Control Act (TSCA) Title VI.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

B. Keep finished surfaces of products covered with polyethylene film or other protective covering during handling and installation.

C. Waste Management: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
   1. Select lumber sizes to minimize waste; reuse scrap lumber to greatest extent possible. Clearly separate scrap lumber for use on site as accessory components, including: shims, bracing, and blocking.
   2. Separate wood waste in accordance with the Waste Management Plan and place in designated areas in the following categories for recycling:
      a. Solid wood; softwood or hardwood.
      b. Composite wood.
      c. Treated, painted, or contaminated wood.
         1) Do not burn scrap lumber that has been pressure treated.
         2) Do not send lumber treated with pentachlorophenol to cogeneration facilities or "waste-to-energy" facilities.
   3. Prevent saw dust and wood shavings from entering the storm drainage system.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating, or temporary facilities are capable of maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide product by the manufacturers specified.
   2. Products: Subject to compliance with requirements, provide one of the products specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 SYSTEM DESCRIPTION

A. Accessibility Requirements: Millwork shall be provided to conform to the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local Regulations. These requirements supersede Technical Specifications in this Section.

B. Performance Requirements
   1. Countertops shall not deflect more than 1/4 inch when a load of 100 pounds per linear foot is applied.
      a. Unsupported countertop spans shall not exceed 48 inches and must be reinforced to prevent deflection in excess of 1/4 inch.

2.3 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the “Architectural Woodwork Standards” for grades of architectural wood cabinets indicated for construction, finishes, installation, and other requirements.
   1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
      a. Grade: Custom.

2.4 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
   1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
   1. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products or shall be made with no added formaldehyde.
   2. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
   3. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde or Grade M-2-Exterior Glue.
   4. Softwood Plywood: DOC PS 1, medium-density overlay.

C. Thermally Fused Laminate (TFL) Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with requirements of ISO 4586-3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
   1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semi-exposed edges. Match color and pattern of thermoset decorative panels.

D. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or, if not indicated, as required by woodwork quality standard.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABET Inc.
      b. Formica Corporation
      c. Laminate LLC
      d. Pionite; a Panolam Industries International, Inc. brand
      e. Wilsonart LLC

2.5 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
   1. Manufacturers: Subject to compliance with requirements, or otherwise noted, provide products by one of the following:
      a. Accuride International
      b. Blum, Julius and Co., Inc.
      c. Comp X Internationa, Inc.
      d. Knape & Vogt Manufacturing Company
      e. Grass America
      f. Hardware Resources
      g. Hettich America L.P.

B. Hardware Standards: Comply with ANSI/BHMA A156.9 for items indicated by referencing ANSI/BHMA numbers or items referenced to this standard.

C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter, unless otherwise noted, comply with ANSI/BHMA A156.4, B02011.

D. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141, roller catches, ANSI/BHMA A156.9, B03071, or ball friction catches, ANSI/BHMA A156.9, B03013.
   1. Catches shall comply with ADA requirements for pounds of pull required to open doors.
   2. Provide two (2) catches on doors more than 48 inches high.
   3. Chain Stops
      a. Install on the following:
         1) Operable doors of tall wardrobe units and cabinets.
         2) Other operable doors that are restricted from swinging 180 degrees.
      b. Length of chain shall allow doors to open 90 degrees minimum.
         1) Exception: Shorten chain if required to prevent door or door handles from hitting obstructions.
   4. Provide push-in magnetic catches, ANSI/BHMA A156.9, B03131, where indicated.

E. Adjustable Shelf Supports: Injection molded transparent polycarbonate friction fit into cabinet end panels and vertical dividers, adjustable on 1-inch centers. Each shelf support has 2 integral support pins, to interface pre-drilled holes, and to prevent accidental rotation of support. Support also provides non-tip feature for shelving.
   1. Structural load to support 1200 lbs. without failure.

F. Drawer Slides: BHMA A156.9, Type B05091.
   1. Regular drawers, knee space and pencil: Epoxy coated steel, bottom corner mounted with smooth quiet nylon rollers.
      a. Positive stop both directions with self-closing feature.
      b. Loading: 100-pound load capacity.
   2. Paper Storage: 150-pound load rated epoxy coated steel slides.
   3. File Drawers: Full extension, epoxy coated steel, bottom corner mounted with smooth and quite nylon rollers.
      a. Positive stop both directions with self-closing feature.
      b. Loading: 150-pound load capacity.

G. Drawer and Hinged Door Locks:
   1. Cylindrical (cam) or mortise type, 5-pin tumbler, brace with chrome-plated finish, and complying with ANSI/BHMA A156.11, Grade 1.
   2. Provide locks on all doors and drawers, unless otherwise noted.

H. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

I. Grommets for Cable Passage through Countertops: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
   1. Basis-of-Design: Mockett 93P Putty

J. Exposed Hardware Finishes: As indicated in “Casework Schedule” or “List of Finishes” on drawings.

2.6 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

2.7 FABRICATION, GENERAL

A. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of openings in countertops with a coat of varnish.

2.8 PLASTIC-LAMINATE CABINETS

A. Type of Construction: Face Frame.

B. Cabinet, Door, and Drawer Front Interface Style: Reveal overlay, unless otherwise indicated.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
   1. Horizontal Surfaces Other Than Tops: Grade HGS.
   2. Vertical Surfaces: Grade HGS or VGS.
   3. Edges: PVC edge banding 3mm thick, through-color in satin finish matching laminate in color and pattern, as indicated.
      a. Provide PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish, where indicated.

D. Materials for Semi-exposed Surfaces:
   1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS, High-pressure decorative laminate, Grade CLS, or Thermally Fused Laminate (TFL).
      a. Edges of Plastic-Laminate Shelves: 0.018-inch, matching laminate in color and pattern as indicated.
         1) Plastic laminate matching adjacent surfaces only where indicated.
      b. Impact resistant PVC edge-banding, 1mm thick, through-color in satin finish.
         1) Unless otherwise indicated, provide specified edge-banding on all semi-exposed edges.
      c. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS or CLS.
   2. Drawer Sides and Backs: Solid-hardwood lumber or thermoset decorative panels.
   3. Drawer Bottoms: Hardwood plywood or thermoset decorative panels.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. Refer to “List of Finishes”.

G. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

H. Drawer Construction: Fabricate with exposed fronts fastened to sub-front with mounting screws from interior of body.
   1. Join sub-fronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

2.9 COUNTERTOPS, GENERAL

A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch over base cabinets.
   1. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   2. Shop cut openings to maximum extent possible to receive fixtures and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings.
      a. For plastic-laminated clad countertops: Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.

2.10 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with ANSI/AWI 1236 for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.
   1. The Contract Documents may contain requirements that are more stringent than that of the referenced quality standard. Comply with requirements of the Contract Documents in addition to those of referenced quality standard.

B. Plastic-Laminate Tops: Plastic-laminate sheet, shop bonded to both sides of 1-1/8-inch particleboard, unless otherwise indicated. Sand surfaces to which plastic laminate is to be bonded.
   1. Plastic Laminate for Flat Tops: ISO 4586-3, Grade HGS, unless otherwise noted.
   2. Plastic Laminate for Backing: Grade BKL.
   3. Edge Treatment: Provide 3-mm PVC edging on front edge of top, on top edges of backsplashes and end splashes, and on ends of tops and splashes.
   4. Use veneer-core plywood made with Type II adhesive or exterior glue particleboard for countertops containing sinks.
   5. Backer Sheet: Provide plastic-laminate backer sheet, ISO 4586-3, grade to match exposed surface, on underside of countertop substrate.
   6. Backsplashes 4-inch high scribable, square set; color matching, and mechanically attached, with endsplashes.
      a. Provide at locations where countertops abut walls and where otherwise indicated.
      b. Backsplashes shall have a moisture-resistant core.
   7. Colors and Patterns: As indicated in “List of Finishes”.

2.11 BUTCHER BLOCK COUNTERTOPS

A. Refer to Division 12 Section “Wood Countertops”.

2.12 ACCESSORIES

A. Support Members: Provide the following where necessary for countertops to meet “Performance Requirements”.
   1. Countertop Support Brackets: Wall mounted, heavy duty, welded aluminum brackets for support of countertops and work surfaces.
      a. Extruded aluminum complying with ASTM B221, 6063-T5 alloy.
      b. Finish: Clear Anodized.
      c. Size: As required by countertop width to support.
      d. Product: As indicated on Drawings as manufactured by Rangine Corporation (Rakks).

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas for not less than 72 hours.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Assemble cabinets and woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

B. Install cabinets and woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

C. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Anchor cabinets and woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
   2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood blocking, or hanging strips or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
   3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood blocking, or hanging strips, No. 10 wafer-head sheet metal screws through metal backing or metal backing, or metal framing behind wall finish toggle bolts through metal backing or meal framing behind wall finish.

3.3 INSTALLATION OF PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in shop.
   1. Provide cutouts for plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   2. Seal edges of cutouts in plastic-laminate by saturating with varnish.

C. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings. Scribe tops and backsplashes to walls and other adjoining vertical surfaces.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

E. Scribe and cut plastic-laminate-clad countertops to fit adjoining work, refinish out surfaces, and repair damaged finish at cuts.

F. Secure tops to cabinets with Z- or L-type fasteners or equivalent, using two or more fasteners at each front, end, and back.

G. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
1. Install countertops with no more than 1/8 inch in 96 inch sag, bow, or other variation from a straight line.

H. Secure backsplashes and end splashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.

I. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets and woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 41 16

SECTION 06 42 19 – PLASTIC-LAMINATE-FACED WOOD PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following: Plastic-laminate-faced wood paneling.
   1. Decorative 3/4-inch-thick prefinished panel with pre-engineered attachment clip along with hardware and trim systems for installation directly to studs.
      a. Hardware: Aluminum cross rails and cross splines.
      b. Panels: High pressure laminate adhered to wood fiber substrate and having a balancing backer sheet.

B. Related Sections include the following:
   1. Division 06 Section(s) “Miscellaneous Rough Carpentry” for wood furring, blocking, shims, and hanging strips required for installing paneling that is concealed within other construction before paneling installation.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

B. Pre-Installation Conference: Conduct conference at Project site.

1.3 SUBMITTALS

A. Product Data: For panel products, including sufficient manufacturer’s data to indicate compliance with these specifications including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Include data for fire-retardant-treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: Show location of paneling and trim members, large-scale details, attachment devices, and other components with respect to all discontinuities in the wall elevation. Include dimensioned plans and elevations.
   1. Show details full size.
   2. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.

C. Samples for Initial Selection: For each type of plastic laminate.

D. Samples for Verification: For each type of exposed laminate, 8 by 10 inches.
   1. Provide one Sample applied to core material [and with specified edge material applied to one edge].

1.4 QUALITY ASSURANCE

A. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of paneling indicated for construction, finishes, installation, and other requirements.

B. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:

1. ASTM E 84: Class C, unless otherwise noted on “Code Plan”.

C. Mockups: Build mockups to verify materials, finish, and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Size: First-in-place 50 sq.ft. of each material including accessories shall serve as a mockup.
   2. Approval of mockup does not constitute approval of deviations from the Contract Documents contained in mockups, unless A/E specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approval mockups may become part of the completed work, if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver paneling until painting and similar operations that could damage paneling have been completed in installation areas. If paneling must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

B. Deliver panels and associated materials factory packaged on strong pallets and properly packaged or protected.

C. Store products in manufacturer’s unopened packaging until ready for installation.

D. Waste Management: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Select lumber sizes to minimize waste, reuse scrap lumber to greatest extent possible. Clearly separate scrap lumber for use on-site as accessory components, including shims, bracing, and blocking.
   2. Separate wood waste in accordance with the Waste Management Plan and place in designated areas in the following categories for recycling:
      a. Solid wood; softwood or hardwood.
      b. Composite wood.
      c. Treated, painted or contaminated wood.
         1) Do not burn scrap lumber that has been pressure treated.
         2) Do not send lumber treated with pentachlorophenol to cogeneration facilities or “waste-to-energy” facilities.
   3. Prevent saw dust and wood shavings from entering the storm drainage system.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.

C. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating paneling without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

D. Do not install materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet, or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Surface Systems – MAP System; Marlite, Dover, Ohio or a comparable product by one of the following:
1. MDC Wallcoverings Inc.
2. Panel Specialties, Inc.
3. Wall Panel Systems, Inc.
4. Architectural Components Group, Concerto Wall System

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany request for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 HARDWARE

A. Horizontal main rail and vertical cross spline alignment framing.
1. CMR – Channel Main Rail, to create detailed 1/2-inch reveals.

B. Panel Trim: Aluminum Profiles
1. Outside Corner: Narrow profile; Marlite #NL-760.
2. Edge/Inside Corner: Narrow profile; Marlite #NL-770.

C. Hardware and Trim Material
1. Aluminum-heavy weight extruded aluminum 6063-T5 alloy and prefinished at factory.
a. Concealed Aluminum: Mill finished.
b. Exposed Aluminum: Black satin anodized, unless otherwise noted.

2.3 PANELS

A. High Pressure Laminate: Vertical grade high pressure plastic laminate complying with NEMA LD3 adhered to wood fiber substrate.
1. Edges: Square and sealed, to provide a black edge.
2. Balanced Backer: Kraft paper that does not contribute to or pose an unusual additional fire hazard.

B. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed surfaces complying with the following requirements:
1. As indicated in “List of Finishes” on drawings.
2. Grain Direction: Vertical.

C. Panel Core: Particleboard or MDF.
1. Thickness: As indicated.

D. Fire-Retardant-Treated Paneling: Panels are to consist of fire-retardant plastic laminate and fire-retardant particleboard or fire-retardant, medium-density fiberboard (MDF). Panels are to have a flame-spread index of 25 or less and smoke-0developed index of 450 or less per ASTM E84, and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

2.4 FABRICATION

A. Complete fabrication, including assembly, to maximum extent possible, before shipment to project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide sample allowance for scribing, trimming, and fitting.

B. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

C. All framing, panels, hardware and accessories shall be factory finished and ready to install except for field fabrication as required by jobsite and perimeter conditions.
   1. Refinish field cut panel edges in accordance with manufacturer's instruction before installation.
   2. For all cut-outs, drill corners for a minimum 1/8-inch radius.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition paneling to average prevailing humidity conditions in installation areas.

B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION, GENERAL

A. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
   1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/16 inch.

B. Scribe and cut paneling to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

C. Anchor paneling to supporting substrate with concealed panel-hanger clips and splined connection strips. Do not use face fastening.

3.3 PANELING INSTALLATION

A. Install all materials in strict accordance with the manufacturer's installation instructions with hardware straight, plumb, and level.
   1. Anchor units rigidly and securely in place.
   2. Cut panels to meet supports.

B. Fasten supports and trim using #6 trim-head screws anchored into a stud at 16-inch centers. Pre-drill holes through the members and fasten the screw flush with the flange on the aluminum profile. Where necessary countersink for the screw head to seat flush with the flange.

3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective paneling, where possible, to eliminate functional and visual defects; where not possible to repair, replace paneling. Adjust for uniform appearance.

B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 42 00

SECTION 06 64 00 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plastic sheet paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Submit manufacturer's data to indicate compliance with these specifications, including:
   1. Storage, handling, preparation and installation instructions and recommendations.
   2. Provide written data including physical characteristics, such as durability, resistance to fading, and flame resistance.
   3. Include manufacturer's installation instructions, including manufacturer's recommendations for maximum permissible moisture content of substrates.

B. Shop Drawings: Show location, extent, and installation details. Include indication of wall covering termination points. Provide elevations and details of conditions not included in Product data or installation instructions.

C. Samples for Initial Selection: For initial selection of color, pattern, and surface texture, provide the manufacturer's standard color chips consisting of actual sections of each vinyl plastic material required showing full range of materials, colors, and textures available.

D. Samples for Verification: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.3 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction.

B. Qualifications: Products shall not support mold or mildew as tested per ASTM D 3273 and ASTM D 3274.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original factory wrappings, clearly labeled with identification of manufacturer, brand name, lot number, quality of grade, and fire hazard classification.

B. Store materials inside in original undamaged packages in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Do not store rolled goods upright, lay flat, blocked off the ground to prevent sagging and warping.
   1. Keep sheet material out of direct sunlight to avoid surface distortion.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for Architect/Engineer's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with
   1. ASTM E84 (method of test for surface burning characteristics of building materials) Wall Required Rating – Class A.

2.3 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Marlite.
      b. Crane Composites, Inc.
      c. Glasteel.
      d. Newcourt, Inc.
      e. Nudo Products, Inc.
      f. Parkland Plastics, Inc.
   2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.
   3. Nominal Thickness: Not less than 0.09 inch.
   4. Surface Finish: Smooth.
   5. Color: As indicated in "List of Finishes".

2.4 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
   1. Color: Match panels.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer and that complies with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Examine substrate to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matters, nails countersunk, joints and cracks filled flush and smooth with adjoining surface.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

D. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels and so that trimmed panels at corners are not less than 12 inches wide.
   1. Mark plumb lines on substrate at trim accessory and panel joint locations for accurate installation.
   2. Locate trim accessories and panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions for application indicated.

B. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

C. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 06 64 00

SECTION 07 19 00 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:
   1. New Clay brick masonry.

B. Related Sections:
   1. Division 04 Section “Unit Masonry”

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Meeting: Conduct meeting at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include manufacturer's printed statement of VOC content.
   2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Qualification Data: For qualified Applicator and testing agency.

B. Preconstruction Testing Reports: For water-repellent-treated substrates.

C. Warranty: Special executable warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

B. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, for preconstruction testing, and to set quality standards for materials and execution.
   1. Locate each test application as directed by A/E.
      a. Size: 10 sq. ft.
   2. Final approval by A/E of water-repellent application will be from test application.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless A/E specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Installed water repellents shall comply with performance requirements indicated, as evidenced by reports based on Project-specific preconstruction testing of existing substrate assemblies by a qualified testing agency.
   1. Select sizes and configurations of assemblies to adequately demonstrate capability of water repellents to comply with performance requirements.
   2. In addition to verifying performance requirements, use test applications to verify manufacturer's written instructions for application procedure and optimum rates of product application to substrate assemblies.

3. Propose changes to materials and methods to suit Project.
4. Notify A/E seven days in advance of the dates and times when assemblies will be tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 35 deg. F. and not more than 110 deg. F, in accordance with manufacturer's written instructions.
1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.
3. Protect materials from direct sunlight.

B. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management" and as follows:
1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.
2. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.

1.8 PROJECT CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
1. Masonry surfaces and mortar have cured for not less than 28 days.
2. Building has been closed in for not less than 30 days before treating wall assemblies.
3. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
4. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
5. Rain or snow is not predicted within 24 hours.
6. Not less than 24 hours have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.
1. Products: Subject to compliance with requirements, provide one of the products specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for Architect/Engineer's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.
   1. Water Repellents: Comply with performance requirements specified, as determined by preconstruction testing on manufacturer's standard substrate assemblies representing those indicated for this Project.

B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.
   1. Clay Brick: ASTM C 67.

C. Water-Vapor Transmission: Comply with one or both of the following:
   1. Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, according to ASTM E 96.
   2. Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, according to ASTM D 1653.

D. Durability Maximum 5 percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.

2.3 PENETRATING WATER REPELLENTS

A. Low VOC, Silane, Penetrating Water Repellent: Clear, containing 40 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.
   1. Products: Subject to compliance with requirements, as recommended by manufacturer for substrates indicated:
      a. Advanced Chemical Technologies, Inc.
      b. MBCC Group.
      c. Chemical Products Industries, Inc.
      d. Dayton Superior Corporation.
      e. Foxfire Industries, Inc.
      f. LymTal International, Inc.
      g. Nox-Crete Products Group.
      h. Pecora Corporation.
      i. Price Research, Ltd.
      j. PROSOCO, Inc.
      k. Waterstopper S-40 Silane; Specco Industries, Inc.
      l. Baracade Silane 100, Euclid Chemical Company (The).
      m. Textured Coatings of America, Inc.
      n. Tnemec Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
   1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
   2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
   3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
   4. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. New Construction and Repairs: Allow cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.

B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:
1. Clay Brick Masonry: ASTM D 5703.

C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, using 15 psi-pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:
1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance of water-repellent material with product requirements.

B. Coverage Test: In the presence of A/E, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.
1. Notify A/E seven days in advance of the dates and times when surfaces will be tested.
2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by A/E.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 07 19 00

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Extruded polystyrene foam-plastic board insulation for perimeter underslab applications.
2. Glass-fiber blanket insulation.
3. Miscellaneous spray polyurethane foam insulation.

B. Related Sections:
1. Division 03 Section “Cast-in-Place Concrete” for underslab vapor barriers or reglets.
2. Division 05 Section “Cold-Formed Metal Framing” for coordination.
3. Division 07 Section ‘Boardstock Air Barrier” for insulating and sealing non-accessible part of wall assembly.
4. Division 07 Sections "Thermoplastic Membrane Roofing" for insulation specified as part of roofing construction.
5. Division 07 Section "Joint Firestopping" for insulation installed as part of a perimeter fire-resistive joint system.
6. Division 09 Section(s) "Gypsum Board Assemblies” for sound attenuation blanket used as acoustic insulation.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate with other thermal assemblies and air barrier assemblies to provide a complete thermal envelope.
1. Fill gaps around penetrations to prevent gaps in thermal envelope.

B. Sequence: Sequence installation of insulation so materials can be installed for optimum performance.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Certification: Certify materials contain less than one percent asbestos or polychlorinated biphenyls (PCB).

B. Product Test Reports: Upon request, submit fire and thermal test reports performed by a qualified testing agency.
1. Spray-Foam: Submit the technical data sheet from the manufacturer showing the test results from the ASTM E84 (Surface Burning Characteristics).

C. Evaluation Reports: Upon request, submit the following:
1. For intumescent coating, documentation from an independent testing laboratory that demonstrates that it satisfies the Acceptance criteria for Spray-Applied Foam Plastic Insulation (AC377) to serve as the code-mandated thermal barrier over polyurethane foam.
2. For spray-applied polyurethane foam-plastic insulation, from ICC-ES or other third party certifiers approved by authorities with jurisdiction.

D. Qualification Data: For spray polyurethane foam installer.

1.5 QUALITY ASSURANCE

A. Polyurethane Foam Installer Qualifications: An authorized representative who is trained and approved by manufacturer or certified by the Spray Polyurethane Foam Alliance through the SPFA-PCP as an insulation installer or higher certification.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Materials to be delivered to the site in original labeled and unopened packages, clearly labeled with manufacturer's name, product identifications, safety information, and batch or lot numbers, where appropriate. Where materials are covered by a referenced specification, the labels shall bear the specification number, type, and class, as applicable.
   1. Material shall be stored in a safe manner and where the temperatures are in the limits specified by the material manufacturer.

B. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
   1. Bonding adhesives must be kept from freezing at all times.

C. Protect foam-plastic board insulation as follows:
   1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
   3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

D. Waste Management: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.
   2. Plan and coordinate the insulation work to minimize the generation of cutoffs and waste. Reuse insulation scraps to the maximum extent feasible.

1.7 FIELD CONDITIONS

A. Environmental Conditions: Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
   1. Protect adjacent surfaces, windows, equipment, and site areas from damage of overspray.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Products: Subject to compliance with requirements, provide one of the products specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Reference Standards:
1. NFPA: Foam plastics left exposed to the interior occupied space must be covered by a thermal barrier or show compliance to NFPA 286 for flame spread classifications for specific materials or assemblies.

B. Compliance with Manufacturer’s Requirements: Insulation materials shall be installed in accordance with manufacturer’s recommendations and in such a manner as to achieve rated R-value of insulation.

2.3 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION (XPS)

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Foamular ThermaPink 25; Owens Corning:
b. Kingspan Insulating, LLC
c. DuPont
d. DiversiFoam Products
e. Foam-Control Plus+; ACH Foam Technologies
f. Atlas EPS
2. Type IV, 25 psi.
3. Thermal resistance of 1-inch thickness, min. F-ft^2 h/Btu (75 deg F): 5.0

2.4 GLASS-FIBER BLANKET INSULATION

A. Design Requirements: Products that have been manufactured fabricated and installed to the following criteria:
1. Fire Test Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing protocol required to achieve UL Classified rated per UL 723 or by testing identical products according to ASTM E84 by a qualified testing agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
2. Insulation shall comply with the requirements of the California Department of Public Health’s “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.”

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CertainTeed Corporation
2. Johns Manville
3. Knauf Insulation
4. Owens Corning

C. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per UL 723 or ASTM E 84; passing ASTM E 136 for combustion characteristics.

D. Thermal Resistance

1. R-value: 1.3 hr./ft2/f Btu
2. RSI value: 2.3
3. Thickness: As indicated.

E. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.5 SPRAY POLYURETHANE FOAM INSULATION/THERMAL BARRIER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bayer Material Science: Bayseal with one of the following thermal barriers:
   a. Bayseal IC Intumescent Coating, Bayer
   b. Flame Seal TB, Flame Seal Products
   c. TPR^2 Fireshell BMS-TC, TPR^2 Corporation
   d. DC 315, International Fireproof Technology
2. Icynene Inc.: Icynene ProSeal Eco with the following thermal barrier:
   a. DC 315, International Fireproof Technology
3. Henry Company: Permax 2.0X with one of the following thermal barriers:
   a. Flame Seal TB, Flame Seal Products
   b. TPR^2 Fireshell BMS-TC, TPR^2 Corporation
   c. DC 315, International Fireproofing Technology
4. MBCC Group: Spraytite, Comfort Foam and Walltite with one of the following thermal barriers:
   a. Aldocoat 800, Aldo Products
   b. Noburn Plus, No-Burn Inc.
   c. Spraycoat 1920, MBCC Group
   d. Flame Seal TB, Specialty Products
   e. DC 315, International Fireproof Technology
5. Johns Manville: Corbond III with one of the following thermal barriers:
   a. JM TC Thermal Barrier Intumescent Coating, Johns Manville.
   b. Flame Seal TB, Flame Seal Products.
   c. TPR^2 Fireshell BMS-TC, TPR^2 Corporation.
   d. DC 315, International Fireproofing Technology.
6. NCFI Polyurethane: InsulBloc with the following thermal barrier.
   a. DC 315, International Fireproofing Technology.
7. Huntsman Building Solutions: Heatlok HFO Pro with one of the following thermal barriers.
   a. DC-315 Fireproof Paint
   b. No-Burn Plus ThB
   c. Blazelox TBX
8. Gaco Western: GacoOnePass F1850
   a. DC 315; International Fireproofing Technology
   b. No-Burn Plus ThB

B. Closed-Cell Polyurethane Foam Insulation with Thermal Barrier: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
1. Minimum density of 1.5 lb./cu. ft., thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F.
2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
3. Thermal Barrier: Provide an intumescent coating that has been qualified as the code-mandated thermal barrier over polyurethane foam by room corner tests conducted in accordance with NFPA 286 or UL 1715 as acceptable to authorities with jurisdiction.

2.6 ACCESSORIES

A. Wire Mesh Lath Support for Insulation: ASTM C1032

1. Material: Woven wire lath 1-1/2 inch hexagonal-shaped mesh with minimum 0.0510-inch diameter, galvanized-steel wire.

B. Welded Wire Fabric: Cold drawn 10 gauge steel wire, electrically welded at the intersection of the transverse and longitudinal wires, which are both spaced 6 inches apart. Fabric shall conform to ASTM A 185 and be identified as 6 x 6-10 WWF.

C. Sprayed Polyurethane Foam Sealant (Insulation for Miscellaneous Voids): 1 or 2 component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb./cu.ft. density; flame spread index of 25 or less according to ASTM E162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
1. Provide single-component polyurethane sealant low expansion pressure specifically designed for sealing perimeter of openings.
2. Use one-component foam for cracks or openings 1/4-inch to 2-inch wide. Use two-component foam sealant for gaps over 2-inches wide and for voids in hidden cavities.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with installer present, for compliance with requirements of Sections in which substrates and related work are specified and, for other conditions affecting performance.

B. Examine sizes and conditions of voids to be sealed to establish correct thicknesses and installation of materials per manufacturer's recommendations.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate surfaces to remove moisture, dirt, dust, grease, oil, loose material, or other matter which may affect bond of foam sealant material. Ensure surfaces are dry before proceeding with installation.
1. Remove incompatible materials that may affect bond.
2. Install backing and damming materials for foam sealant to arrest material leakage and for support.
3. Mask, using masking tape, where necessary to avoid spillage and over coating onto adjoining finish surfaces; remove stains on adjacent surfaces. Remove tape as soon as possible without disturbing foam sealant.
4. Install primer on oily surfaces and galvanized steel.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Spray Polyurethane Foam Insulation Priming: Prime Substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer’s written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.

B. On horizontal surfaces under slabs, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 36 inches in from exterior walls.

3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
   4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   1. Spray Polyurethane Insulation or Foam Sealant (Exterior Walls): Apply according to manufacturer's written instructions.
      a. Apply sealants within recommended application temperature ranges. Consult manufacturer when sealants cannot be applied within recommended ranges.
         1) In low humidity, mist area with water to aid cure of one-component sealant.
      b. Provide continuity of thermal barrier by sealing the following areas within the construction and construction assemblies. Note that these areas are typical in nature and do not limit the application of these products to these noted areas, but any and all details within the construction that present similar characteristics should receive similar applications.
         1) Opening head, jamb, and sill areas at cavity wall.
         2) Roof/Wall Junctions: Inspect roof/wall perimeter for thermal gaps in areas such as the fluted deck itself, truss and structural beam penetrations above and below the top of the wall, open joints, and conduit and pipe penetrations.
            a) Where deck flutes run perpendicular to the wall, foam the open flutes completely out to the fascia.
            b) Where closed flutes occur, punch flutes and inject foam through holes. Locate holes as close to wall as possible so that the plane of injected and cured foam within the closed flute is level with the plane of the exposed foam in the open flutes.
            c) Where steel deck is parallel to the wall, fill the void with either one-component or two-component material, depending on gap size.

3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 25 00 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Building wrap, mechanically attached water-resistive weather barrier membrane.

B. Related Requirements:
   1. Division 04 Section “Unit Masonry” for thru-wall flashing.
   2. Division 06 Section “Sheathing” for coordination with plywood sheathing.
   3. Division 07 Section “Boardstock Air Barrier” for transition membranes.
   4. Division 07 Section “Metal Composite Material Wall Panels” for coordination.

1.2 SCHEDULING

A. Review requirements for sequencing of installation of weather barrier assembly and installation of windows, doors, louvers, and flashings to provide a weather-tight barrier assembly.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Building Wrap:
      a. Include data on air and water-vapor permeance based on testing according to referenced standards.
      b. Include details of building wrap at terminations, openings, and penetration. Show details of flexible flashing applications.
      c. Manufacturer’s Instructions: Provide manufacturer’s written installation instructions.

B. Shop Drawings: Show details of building wrap at terminations, openings, and penetrations. Show details of flexible flashing applications.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier**,** from ICC-ES. AC38 – Acceptance Criteria for Water-Resistive Barriers.

1.5 QUALITY ASSURANCE

A. Pre-Installation Meeting; Can be conducted in conjunction with metal composite material wall panel preinstallation meeting.
   1. Hold a pre-installation meeting two weeks prior to start of weather barrier installation. Attendees shall include Contractor, A/E, Installer, and Weather Barrier Manufacturer’s Designated Representative. All contractors responsible for creating a continuous place of water tightness shall be present.
   2. Review all related product requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of air/weather barrier assembly materials and components, installer’s training requirements, equipment, facilities and scaffolding, and coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

B. Store roll materials on end in original packaging. Protect rolls from direct sunlight and inclement weather until ready for use.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

A. Building Wrap: ASTM E 1677, Type I with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Tyvek Commercial Wrap; DuPont (E. I. du Pont de Nemours and Company).
      b. Barricade Wrap Plus; Barricade Building Products.
      c. Alpha Protech
      d. Benjamin Obdyke Incorporated
      e. Dorken Systems Inc.
      f. Kingspan Insulation LLC
      g. Typar Geosythetics
   2. Water-Vapor Permeance: Not less than 10 perms per ASTM E 96, Desiccant Method (Procedure A).
   3. Allowable UV Exposure Time: Not less than three months.

B. Accessories
   1. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.
   2. Fasteners: Corrosion-resistant stainless-steel screws with preformed head caps.
      a. Selection of fastener type is subject to substrate type.
         1) Place screws sized to penetrate sheathing through to solid backing or framing by 3/4 inch in conjunction with preformed screw head caps.
   3. Sealants recommended by the weather barrier manufacturer.
   4. Adhesives: Provide as recommended by weather barrier manufacturer.

2.2 ACCESSORIES

A. Requirements: Provide primers, fasteners, seam tapes, flashing, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by weather barrier manufacturer to produce a complete weather barrier assembly and that are compatible with primary weather barrier material and adjacent construction to which they may seal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examination: Verify that surfaces and conditions are ready to accept the Work of this Section.
   1. Notify A/E in writing of any discrepancies. Commencement of the Work or any parts there of shall mean acceptance of the prepared substrates.

B. All surfaces must be sound, clean and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of flashings. Fill voids, gaps in substrate to provide an even surface.

C. Ensure all preparatory work is complete prior to applying weather barrier.

D. Mechanical fasteners used to secure sheathing shall be set flush with sheathing and fastened to solid backing.

3.2 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.

B. Cover sheathing with water-resistive barrier as follows:
   1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
   2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.

C. Building Wrap: Comply with manufacturer's written instructions.
   1. Seal seams, edges, fasteners, and penetrations with tape.
   2. Extend into jambs of openings and seal corners with tape.

3.3 ACCESSORY INSTALLATION

A. Install weather barrier accessories for a complete installation with weather barrier in accordance with manufacturers written instructions.

END OF SECTION 07 25 00

SECTION 07 27 23 - BOARDSTOCK AIR BARRIER

PART 1 - GENERAL

1.2 SECTION INCLUDES

A. This section includes following:
   1. Boardstock air barrier – rigid cellular thermal insulation board located in non-accessible part of wall.
      a. Masonry cavity wall applications.
      b. Cold-formed metal veneer applications.
   2. Air sealing materials to supplement and provide continuity of main or primary air barrier assembly including, but not limited to following:
      a. Connections of walls to roof air barrier.
      b. Connections of the wall to the foundation.
      c. Expansion and control joints.
      d. Openings and penetrations of door and window frames, storefront, curtain wall.
      e. Beam and column enclosures.
      f. Piping, conduit, duct and similar mechanical and electrical penetrations.
      g. Masonry ties, screws, bolts and similar penetrations.
      h. All other air leakage pathways in building envelope.

C. Related Work in other Sections includes following:
   1. Division 04 Section “Unit Masonry” for requirement that backup masonry joints are flush and completely filled with mortar, and that excess mortar on brick ties will be removed; requirement for gap at deflection joints and fillers; coordination with sequencing of through-wall flashing.
   2. Division 05 Section “Cold-Formed Metal Framing” for load-bearing, metal exterior wall framing assemblies to support boardstock air barrier, including a 6 inch strap to secure the flashing termination bar.
   3. Division 06 Section “Miscellaneous Rough Carpentry” for wood blocking at openings.
   4. Division 07 Section “Thermal Insulation” for batt insulation.
   5. Division 07 Section “Thermoplastic Membrane Roofing” for requirement for coordination with sequencing of membrane roofing; requirement to seal roof membrane to wall air barrier.

1.3 REFERENCES

A. NFPA: Foam plastics left exposed to interior occupied space must be covered by a thermal barrier or show compliance to NFPA 286 for flame spread classifications for specific materials or assemblies.
   1. In edition show compliance with NFPA 285 – Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

B. For rough openings of fenestrations sealants must conform to AAMA 812-04.

C. Sealants must have ASTM E84 or UL723 standard testing for surface burning characteristics of building materials.

D. Sealants must be UL classified for foamed plastics as per UL 723 for caulking and sealants.

E. ICC-ES AC 377 acceptance criteria for spray applied foam plastic insulation.

1.4 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to movement of air.

B. Air-Barrier Accessory: A transitional component of air barrier that provides continuity.

C. Air Barrier Assembly: Collection of air-barrier materials and accessory materials applied to opaque wall, including joints and junctions to abutting construction, to control air movement through wall.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination Meeting: Conduct meeting at Project site in accordance with requirements of Division 01 Section “Project Management and Coordination”. Schedule before start of each major segment or wall construction area. Be aware of all contract work that interfaces with wall assemblies as they are being erected. Contractor shall participate in various trade preconstruction meetings that interface with exterior wall assemblies. Educate and advise all workers concerning protection, and cutting and patching procedures.
   1. Attendance: All trades whose work interfaces with wall assemblies.
   2. Verify all openings and penetrating items, pipes, ducts, conduits, and like and ensure sleeves are properly sized and located and capable of being secured.
   3. Review transitions, special penetration details, proposed openings, structural elements, and conditions of other construction that will affect wall assembly.
   4. Review temporary protection requirements. Walls are to be protected from moisture during construction.
   5. Coordinate installation of insulation and accessories with cladding attachment system, air barrier, and other moisture protection work.

B. Pre-Installation Meeting: Conduct meeting at Project Site.
   1. Attendees: A/E, Owner, Contractor, Installer, agent of manufacturer, testing agency representative, and any installer whose work interfaces with or affects exterior envelope, including installers of “openings”.
   2. Review air barrier requirements and installation, special details, mockups, air leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.
   3. Review construction schedule and confirm availability of products, applicator personnel, equipment and facilities.
   4. Review governing regulatory requirements, and requirements as applicable and field quality control procedures.
   5. Review field quality control procedures.

C. Sequencing
   1. Do not install air barrier material before roof assembly has been sufficiently installed to prevent a buildup of water in interior of building.
   2. Do not install work of this Section until work of other trades having an effect on this Section of work has been completed.
   3. Schedule work of other trades so that foam sealants can be inspected prior to being covered by subsequent construction.

1.6 ACTION SUBMITTALS

A. Product Data: Submit Manufacturer’s product data, manufacturer's instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.
   1. Submit letter from primary air barrier material manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that manufacturer’s material.
   2. Include statement from the primary air barrier material manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.
   3. Submit letter from sealant Manufacturer indicating sealant adhesion to air barrier material meet requirements of project.

B. Shop Drawings: Submit shop drawings showing locations and extent of air barrier assemblies and details of all typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings, and details showing how gaps in construction will be bridged, how inside and outside corners are negotiated, how materials that cover materials are secured with air-tight condition maintained, and how miscellaneous penetrations such as conduits, pipes, electric boxes and similar items are sealed. Provide project specific details where manufacturers standard details do not cover condition.
   1. Include VOC content of each material, and applicable legal limit in jurisdiction of project.
   2. Include statement that materials are compatible with adjacent materials proposed for use.
   3. Include details of interfaces with other materials that form part of air barrier.
   4. Shop drawings shall be prepared by air barrier manufacturer or submitted to air installer for use in application and inspection.

1.7 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Quality Assurance Program: Submit evidence of current Contractor accreditation and Installer certification under Air Barrier Association of America's (ABAA) Quality Assurance Program or manufacturer's quality assurance plan approved by A/E.
   1. Submit accreditation number of Contractor and certification number(s) of ABAA Certified Installer(s), if applicable.

B. Product Test Reports: Submit evaluation reports published by independent laboratory indicating evidence of compliance with specified criteria.
   1. NFPA 285 Compliance: Contractor must submit documentation showing all components in wall assembly are in compliance with NFPA 285.

C. Shop Drawings of Mock-Up: Submit shop drawings of proposed mock-ups showing plans, elevations, large-scale details, and connections to test apparatus.

D. Field Test Results of Mock-Up: Submit test results of air leakage test and water leakage test of mock-up in accordance with specified standards, including retesting if initial results are not satisfactory.

E. Compatibility: Submit letter from Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from Manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

1.8 QUALITY ASSURANCE

A. Manufacturer: Obtain primary ABAA listed materials from a single ABAA Evaluated Manufacturer regularly engaged in manufacturing specified rigid cellular thermal insulation board. Obtain secondary materials from a source acceptable to primary materials Manufacturer.

B. VOC Regulations: Provide products which comply with applicable regulations controlling use of volatile organic compounds.

C. Field Quality Assurance: Implement site Quality Assurance Program requirements or manufacturer's field quality assurance plan. Cooperate with inspectors and any independent testing and inspection agencies engaged by Owner, if applicable. Do not cover air barrier assembly until it has been inspected, tested and accepted.

D. Mock-Ups: Build mock-ups to set quality standards for materials and execution. Refer to Division 04 Section "Unit Masonry" for mock-up wall assembly.

1. Build integrated mockups of exterior wall assembly, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
    a. Coordinate construction of mock-ups to permit inspection and testing of air barrier, if required before external insulation and cladding are installed.
    b. If Architect determines mock-ups do not comply with requirements, reconstruct mock-ups and apply air barriers until mock-ups are approved.
2. Approval of mock-ups does not constitute approval of deviations from Contract Documents contained in mock-ups, unless A/E specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mock-ups may become part of completed work if undisturbed at time of Substantial Completion.

E. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups. Air barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
1. Mock-Up Tests for Air and Water Infiltration: Third party testing agency shall test mock-up for air and water infiltration in accordance with ASTM E1186 (air leakage location), ASTM E783 (air leakage quantification) at a pressure difference of 1.56 lb./ft² (75 Pa) and ASTM E1105 (water penetration). Use smoke tracer to locate sources of air leakage. If deficiencies are found, air barrier contractor shall reconstruct mock-up for retesting until satisfactory results are obtained. Deficiencies include air leakage beyond values specified, uncontrolled water leakage, unsatisfactory workmanship.
    a. Perform air leakage test and water penetration test of mock-up prior to installation of cladding and trim but after installation of all fasteners for cladding and trim and after installation of other penetrating elements.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with Manufacturer's name, product, date of manufacture, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by boardstock air barrier Manufacturer. Protect stored materials from direct sunlight.

C. Handle materials in accordance with Manufacturer’s recommendations.

D. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.
2. Place materials defined as hazardous or toxic waste in designated containers.
3. Ensure emptied containers are sealed and stored for disposal away from children.

1.10 FIELD CONDITIONS

A. Environmental Requirements: Install air barrier system work only when weather conditions are in compliance with manufacturer’s specific environmental requirements and conditions will permit work to be performed in accordance with manufacturer’s recommendations and requirements.
1. Compatibility. Do not allow boardstock to come in contact with chemically incompatible materials.
2. Ultra-violet exposure. Do not expose boardstock air barrier to sunlight longer than as recommended by Manufacturer of material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Boardstock Air Barrier assemblies are based on products described herein as manufactured by DuPont. Subject to compliance with requirements, provide named product or options indicated.

B. Products of other manufacturers systems will be considered for acceptance provided they equal or exceed material requirements and functional qualities of specified system. Request for A/E's approval must be accompanied by "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by Project Manager and specification department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum. Manufacturers must submit following:
   1. ABAA approval letter.
   2. Manufacturer details of system, including penetrations, and impact on details within Construction Documents.

2.2 PERFORMANCE REQUIREMENTS

A. Material Performance: Provide materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.004 cfm/ft^2 @ 1.57 psf), when tested in accordance with ASTM E 2178 (unmodified).

B. The water vapor permeance Desiccant method, (Procedure A) and Water method (Procedure B) shall be determined in accordance with ASTM E96 and shall be declared by the material manufacturer.

C. Assembly Performance: Provide a continuous air barrier in form of an assembly that has an air leakage not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.04 cfm/ft^2 @ 1.57 psf) when tested in accordance with ASTM E 2357. Assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall have appropriate accessory materials at such locations.
   1. Assembly shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative, on envelope without damage or displacement and shall transfer load to structure.
   2. Assembly air barrier material shall not displace adjacent materials in assembly under full load.
   3. Assembly shall be joined in an airtight and flexible manner to air barrier material of adjacent assemblies, allowing for relative movement of assemblies due to thermal and moisture variations, creep and anticipated seismic movement.

D. Connections to Adjacent Materials: Provide connections to prevent air leakage at following locations:
   1. Foundation and walls, including penetrations, ties and anchors.
   2. Walls, windows, storefronts and doors.
   3. Different assemblies and fixed openings within those assemblies.
   4. Wall and roof connections.
   5. Floors over unconditioned space.
   6. Walls, floor and roof across construction, control and expansion joints.
   7. Walls, floors and roof to utility, pipe and duct penetrations.
   8. Expansion joints.
   9. All other potential air leakage pathways in building envelope.

E. Water Penetration: When tested in accordance with ASTM E331, no uncontrolled water penetration shall occur at a minimum differential pressure of 6.24 psf for minimum test duration of 2 hours.

F. Mold Resistance: Thermal wall and air barrier system components shall provide non-food source for fungal growth (no organic materials).

G. Thermal Performance:
1. Cavity Wall Assembly: Rigid closed cell extruded polystyrene foam insulation (assembly): ASTM C 518, stabilized R-value of 5.6 of one inch of thickness (measured at 75 degrees F.)
   a. Thickness/R-Value: 2-1/8 inches and R-12.00, minimum.
2. Cold-Formed Metal Framing Cavity: Glass-fiber-reinforced enhanced polyisocyanurate from core sheathing.
   a. Thickness/R-Value: 1.55 inch/R-10 minimum.

2.3 AIR BARRIER MATERIALS

A. Boardstock Air Barrier – Rigid Cellular Thermal Insulation Board: Air Barrier at Cold-Formed Metal Veneer Applications. Subject to compliance with requirements, provide one of following:
1. Material: Thermax Wall System by DuPont. Glass-fiber-reinforced enhanced polyisocyanurate foam core sheathing faced with nominal 4 mil embossed grey acrylic-coated aluminum on one side and 1.25 mil embossed aluminum on other side (THERMAX XARMOR). Thickness as indicated on construction drawings. www.dow.com
   a. Air Barrier Material Properties:
      1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0002 cfm/ft2 @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 2.29 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential 0.04 US perms at 1.0" when tested in accordance with ASTM E96 (desiccant method - unmodified).
      3) Maximum Use Temperature: 250 degrees F.
   b. Air Barrier Accessory Materials:
      1) Fasteners: Provide insulated sheathing manufacturer's recommended polymer or other corrosion-protective coated steel screw fasteners for anchoring sheathing to metal wall framing. Fastener length and size based on wall sheathing thickness.
         a) Acceptable Products: TRUFAST Walls Thermal-Grip ci Prong Washer with Grip Deck Self Drilling Screws.
      2) Insulation Flashing: Provide insulation manufacturer's recommended board joint flashing for sealing joints, seams and veneer tie penetrations through insulation layer.
         a) Acceptable Products: DuPont Performance Building Solutions LIQUIDARMOR QS 50+/-5 wet mils thick, 3" MIN width with 1" MIN width on each side of the joint, when covering a washer 1" MIN width to extend onto the substrate from the edge of the washer; or LIQUIDARMOR LT 30+/-5 wet mills 1" MIN width to extend onto the substrate from the edge of the washer.
      3) Wall Opening Flashing: Provide insulated sheathing manufacturer's recommended flashing sealing window and door wall openings.
         a) LIQUIDARMOR QS acrylic based flashing and sealant with spray or brush application and LIQUIDARMOR LT silicone-based flashing and sealant with trowel or caulk application.
      4) Penetration Filler: Provide insulated sheathing manufacturer's recommended polyurethane foam for sealing penetrations of insulated sheathing.
         a) Acceptable Products: DuPont (fka The Dow Chemical Company) "Great Stuff™ Pro Gaps & Cracks" single-component polyurethane insulating foam sealant.

b) Acceptable Products: DuPont (fka The Dow Chemical Company) “Great Stuff™ Pro Window & Door” single-component polyurethane low-pressure foam sealant.

5) Gap Air Infiltration Filler: Two Component, Quick Cure Polyurethane Foam:

a) Acceptable Products: DuPont (fka The Dow Chemical Company) FROTH-PAK™ Foam Insulation two component, quick-cure polyurethane foam.

.1 NFPA 286 Approval for Exposed use to interior of building without need for a 15-min thermal barrier.

.2 ASTM E-84 Class A.

6) Facer Repair: Provide insulating sheathing manufacturer’s recommended flashing for repairs of damaged facer.

a) Acceptable Products: Dow Chemical Company “LIQUIDARMOR CM” spray flashing and sealant or “LIQUIDARMOR LT” flexible single component silicone flashing.

7) Flexible polyethylene foam gasketing strip to reduce air infiltration between a concrete foundation and sill plate.

a) Acceptable Products: The DuPon “WEATHERMATE SILL SEAL” Foam Gasket.

2. Material: AP Foil-Faced by Johns Manville: The boards can be installed in horizontal or vertical orientation. Thickness as indicated on the construction drawings.

a. Air Barrier Material Properties:

1) Air permeance for this material has been tested and reported as being 0.00013 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00013 cfm/ft^2 at 1.57 psi), at 1.0 inch when tested in accordance with ASTM E2178 (unmodified).

2) Water vapor permeance for this material has been tested and reported as being 3 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential 0.06 US perms at 1.0 inch when tested in accordance with ASTM E96 (desiccant method – unmodified).

b. Air Barrier Accessory Materials

1) Fasteners: Provide insulated sheathing manufacturer’s recommended polymer or other corrosion-protective coated steel screw fasteners for anchoring sheathing to metal wall framing. Fastener length and size based on wall sheathing thickness.

a) Acceptable Products: JM Ultrafast CI Plates and JM Ultrafast CI Phillips screws or equivalent as approved by boardstock manufacturer.

2) Insulation Flashing Tape: Provide insulation manufacturer’s recommended board joint tape for sealing joints, seams and veneer tie penetration through the insulation layer.

a) Acceptable Products: 3M™ All Weather Flashing Tape 8067 or equivalent as approved by boardstock manufacturer.

3) Wall Opening Flashing: Provide insulated sheathing manufacturer’s recommended flashing sealing window and door wall openings.

a) Acceptable Products: 3M™ All Weather Flashing Tape 8067 or equivalent.

4) Penetration Filler: Provide insulated sheathing manufacturer’s recommended material for sealing penetrations of insulated sheathing.

a) Acceptable Products: Tremco Spectrem® 1 or equivalent.

5) Flashing: Provide insulated sheathing manufacturer’s recommended material for counterflashing for masonry through-wall flashings, through-wall flashings and shelf angle flashings.

a) Acceptable Products: Sheet metal.

3. Material: ECOMAXci™ Wall Solution using ECOMAXci™ FR Air Barrier rigid polyisocyanurate boardstock by Rmax. R-value per the construction documents. Boards installed horizontally or vertically, Rmax Solution shield logo facing the exterior, typically 48 inch wide by 96 inch to 192 inch long.
    a. Air Barrier Material Properties:
        1) Air permeance for this material has been tested and reported as being 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft^2 @ 1.57 psf), at 0.75 inch when tested in accordance with ASTM E2178 (unmodified).
        2) Water vapor permeance for this material has been tested and reported as being 0.88 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential 0.02 US perms at 2 inch when tested in accordance with ASTM E96 (desiccant method – unmodified).
    b. Air Barrier Accessory Materials:
        1) Insulation Fasteners: Provide self-taping steel screws with minimum 2 inch diameter solid plastic washer.
            a) Acceptable Products: Rodenhouse Inc. THERMAL-GRIP® ci Prong Washer and Grip-Deck® corrosion resistant. Self-drilling screw or equivalent, as determined by component manufacturer.
            b) Insulation Tape: Provide insulation manufacturer's recommended tape for sealing joints, fasteners, seams, and minor facer repair penetrations through the insulation layer.
                .1 Required Products: Rmax R-SEAL 3000 dead soft aluminum foil tape with cold weather acrylic pressure sensitive adhesive, 4 or 5 inch wide.
            c) Insulation Flashing: Provide insulation manufacturer's recommended flashing for sealing at corners, ceiling and floor transitions, windows, doors, rough openings, control joints, and other through wall penetrations.
                .1 Required Products: Rmax R-SEAL 3000 dead soft aluminum foil tape with cold weather acrylic pressure sensitive adhesive, 4 or 5 inch wide.
            d) Insulation Liquid Flashing: Provide insulation manufacturer's recommended liquid flashing for sealing joints, fasteners, seams, sealing at corners, ceiling and floor transitions, windows, doors, rough openings, other through wall penetrations, and minor facer repair penetrations through the insulation layer.
                .1 Required Products: Rmax R-SEAL 3000 dead soft aluminum foil tape with cold weather acrylic pressure sensitive adhesive, 4 or 5 inch wide.
            e) Insulation Caulk: Provide insulation manufacturer's recommended caulk for sealing small penetrations and anchors.
                .1 Accepted Products: Rmax R-SEAL 2000 LF, Liquid Flashing or equivalent.
            f) Brick Ties: Provide insulation manufacturer's recommended brick ties and sealing washers.
                .1 Required Products: BLOK-LOK BL-607, Heckmann Building Products Pos-I-Tie or equivalent, used in conjunction with Rodenhouse Thermal-Grip Brick-Tie Washer or equivalent.

B. Boardstock Air Barrier at Masonry Cavity Wall Applications

1. Material: Ultra Wall Rigid Board Air Barrier System by DuPont. Extruded-Polystyrene Board Insulation with increased R-value; ASTM C 578, Type IV, but with an aged thermal resistance (R-value) for 1 inch thickness of 5.6 deg F x h x sq.ft./Btu at 75 deg. F at 5 years; closed-cell product with carbon-black filler and extruded with an integral skin. Boards installed horizontally, typically 15-3/4 inch by 96-inch orientation.

a. Air Barrier Material Properties:

1) Air permeance for this material has been tested and reported as being 0.00023 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00023 cfm/ft^2 @ 1.57 psf), at 1.0" when tested in accordance with ASTM E2178 (unmodified).

2) Water vapor permeance for this material has been tested and reported as being < 62.9 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential 1.1 US perms at 1.0" when tested in accordance with ASTM E96 (desiccant method - unmodified).

b. Air Barrier Accessory Materials:

1) Adhesive: Type recommended by insulation manufacturer.

a) Acceptable Products:

.1 “Contech Brands PL 300 Foam Board Adhesive”; ChemRex, Inc.

.2 “Contech Brands Premium Foam Board Adhesive”; ChemRex, Inc.

.3 “Foamgraph PS”; Dacar Products, Inc.

2) Insulation Gap/Perimeter Filler: Single component insulating foam sealant.

a) Acceptable Product

.1 DuPont (fka Dow) Chemical Great Stuff Pro Gaps and Cracks; or DuPont Performance Building Solutions LIQUIDARMOR QS 50+/-5 wet mils thick, 3” MIN width with 1” MIN width on each side of the joint, when covering a washer 1” MIN width to extend onto the substrate from the edge of the washer, of LIQUIDARMOR LT 30+/05 wet mils 1” MIN width with 1/2 inch MIN width an each side of the joint, when covering a washer 1” MIN width to extend onto the substrate from the edge of the washer.

3) Insulation Flashing Tape: Provide insulation manufacturer’s recommended board joint tape for sealing joints, seams and veneer tie penetrations through insulation layer.

a) LIQUIDARMOR QS acrylic based flashing and sealant with spray or brush application and LIQUIDARMOR LT silicone-based flashing and sealant with trowel or caulk application.

4) Wall Opening Flashing: Provide insulated sheathing manufacturer’s recommended flashing sealing window and door wall openings.

a) LIQUIDARMOR QS acrylic based flashing and sealant with spray or brush application and LIQUIDARMOR LT silicone-based flashing and sealant with trowel or caulk application.

5) Penetration Filler: Provide insulated sheathing manufacturer’s recommended polyurethane foam for sealing penetrations of insulated sheathing.

a) Acceptable Products: DuPont (fka The Dow Chemical Company) “Great Stuff™ Pro Gaps & Cracks” single-component polyurethane insulating foam sealant.

b) Acceptable Products: DuPont (fka The Dow Chemical Company) “Great Stuff™ Pro Window & Door” single-component polyurethane low-pressure foam sealant.

c) Acceptable Product: FROTH-PAK Foam Insulation two component, quick-core polyurethane foam.

6) Building Gap Air Infiltration Filler: Two Component, Quick Cure Polyurethane Foam:
   a) Acceptable Products: DuPont (fka The Dow Chemical Company) FROTH-PAK™ Foam Insulation two component, quick-cure polyurethane foam.
   b) NFPA 286 Approval for Exposed use to interior of building without need for a 15-min thermal barrier.
   c) ASTM E-84 Class A.
7) Through Wall Flashing: Refer to Division 04 Section "Unit Masonry".
8) Liquid Spray Flashing: Provide insulation manufacturers recommended board joint commercial liquid spray flashing and sealant for sealing joints, seams, window openings, door openings, counterflashing, and penetrations through insulation layers.
   a) Acceptable Product: DuPont (fka The Dow Chemical Company) "LIQUIDARMOR CM" spray flashing and sealant.
      .1 Make ASTM 2357 standard test method for determining air leakage of air barrier assemblies, as part of an approved assembly with continuous foam insulation.
      .2 Meets ASTM 331 water penetration of existing windows by uniform static air pressure differences, as part of an approved assembly with continuous foam insulation.
      .3 Meets ASTM D412 tensile strength – 340 psi.
      .4 Meets ASTM E96 water transmission – 4 perms at typical application thickness.
      .5 Density – 11.4 pounds/gallons as liquid.
      .6 Application Temperature: 35 degrees F to 120 degrees F.
      .7 3" ± 1" coverage required at board joints.
      .8 UV resistance: 180 days.
      .9 Recommended Thickness of Spray Sealant: 50 ± 5 wet mils around screws, veneer anchors and wall penetrations.
      .10 Passes ASTM D1970/AAMA 714 requirements for nail sealing ability.

2. Material: AP Foil-Faced by Johns Manville. The boards can be installed in horizontal or vertical orientation. Thickness as indicated on the construction drawings. www.jm.com
   a. Air Barrier Material Properties:
      1) Air permeance for this material has been tested and reported as being 0.00013 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00013 cfm/ft^2 @ 1.57 psf), at 1.0" when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 3 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (3 ng/(Pa·s·m^2) at 1.0" when tested in accordance with ASTM E96 (desiccant method - unmodified).
   b. Air Barrier Accessory Materials:
      1) Fasteners: Provide insulated sheathing manufacturer's recommended polymer or other corrosion-protective coated steel screw fasteners for anchoring sheathing to metal wall framing. Fastener length and size based on wall sheathing thickness.
         a) Acceptable Products: JM Ultrafast CI Plates and JM Ultrafast CI Phillips screws or equivalent as approved by boardstock manufacturer.

2) Insulation Flashing Tape: Provide insulation manufacturer's recommended board joint tape for sealing joints, seams and veneer tie penetrations through the insulation layer.
   a) Acceptable Products: 3M™ All Weather Flashing Tape 8067 or equivalent as approved by boardstock manufacturer.
3) Wall Opening Flashing: Provide insulated sheathing manufacturer's recommended flashing sealing window and door wall openings.
   a) Acceptable Products: 3M™ All Weather Flashing Tape 8067 or equivalent
4) Penetration Filler: Provide insulated sheathing manufacturer's recommended material for sealing penetrations of insulated sheathing.
   a) Acceptable Products: Tremco Spectrem® 1 or equivalent
5) Flashing: Provide insulated sheathing manufacturer's recommended material for Counter-flashing for Masonry Through-Wall Flashings, Through-Wall Flashings and Shelf Angle Flashings.
   a) Acceptable Products: Sheet metal

3. Material: ECOMAXci™ Wall Solution using ECOMAXci™ FR Air Barrier rigid polyisocyanurate boardstock by Rmax. R-value per the construction documents. Boards installed horizontally or vertically, Rmax Solution shield logo facing the exterior, typically 48 inch wide by 96 inch to 192 inch long. www.Rmax.com/ECOMAXci.
   a. Air Barrier Material Properties:
      1) Air permeance for this material has been tested and reported as being 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft^2 @ 1.57 psf), at 0.75" when tested in accordance with ASTM E2178 (unmodified).
      2) Water vapor permeance for this material has been tested and reported as being 0.88 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (0.88 ng/(Pa·s·m^2) when tested in accordance with ASTM E96 (desiccant method - unmodified).
   b. Air Barrier Accessory Materials:
      1) Insulation Fasteners: Provide self-taping steel screws with minimum 2 inch diameter solid plastic washer.
         a) Acceptable Products: Rodenhouse Inc. THERMAL-GRIP® ci Prong Washer and Grip–Deck® corrosion resistant, Self-drilling Screw or equivalent, as determined by component manufacturer.
      2) Insulation Tape: Provide insulation manufacturer's recommended tape for sealing joints, fasteners, seams, and minor facer repair penetrations through the insulation layer.
         a) Required Products: Rmax R-SEAL 3000 dead soft aluminum foil tape with cold weather acrylic pressure sensitive adhesive, 4 inch or 5 inch wide.
      3) Insulation Flashing: Provide insulation manufacturer's recommended flashing for sealing at corners, ceiling and floor transitions, windows, doors, rough openings, control joints, and other through wall penetrations.
         a) Required Products: Rmax R-SEAL 6000 woven polyethylene flashing membrane with a butyl rubber adhesive, 9 inch or 12 inch wide.
      4) Insulation Liquid Flashing: Provide insulation manufacturer's recommended liquid flashing for sealing joints, fasteners, seams, sealing at corners, ceiling and floor transitions, windows, doors, rough openings, other through wall penetrations, and minor facer repair penetrations through the insulation layer.
         a) Required Products: Rmax R-SEAL 2000 LF Liquid Flashing, one-component, non-sag, flexible, flashing and water barrier sealant.

5) Insulation Caulk: Provide insulation manufacturer's recommended caulk for sealing small penetrations and anchors.
   a) Acceptable Products: Rmax R-SEAL 2000 LF, Liquid Flashing or equivalent
6) Brick Ties: Provide insulation manufacturer's recommended brick ties and sealing washers.
   a) Acceptable Products: BLOK-LOK BL-607, Heckmann Building Products Pos-I-Tie or equivalent, used in conjunction with Rodenhouse Thermal-Grip Brick-Tie Washer or equivalent.

C. Extruded-Polystyrene Board Insulation (for vertical applications below floor line and horizontal application at stops): ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Kingspan Insulating, LLC (EPD)
      b. DuPont (EPD)
      c. DiversiFoam Products (Recycle)
   2. Type IV, 25 psi.
   3. Thermal resistance of 1-inch thickness, min. F-ft^2 h/Btu (75 deg F): 5.0
   4. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
   5. Smoke-Developed Index: No more than 450 when tested in accordance with ASTM E84.
   6. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which air barrier assembly will be installed, with manufacturer's representative, for compliance with requirements.
   1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.
   2. At end of each working day Contractor shall provide weather protection at top of parapet walls and non-finished roofs to prevent moisture migration into walls and damage to installed air barrier systems.
      a. Protecting the walls from moisture during construction is the most effective means in preventing damage to the installed air barrier. Proceeding with installation of the air barrier assembly when walls have not been protected from moisture ingress from above is taking a huge gamble on the performance and durability of installed system.
   3. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
   4. Ensure that following conditions are met:
      a. Surfaces are sound, dry, even, and free of excess mortar or other contaminants
      b. Inspect concrete surfaces to be smooth without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable to be repaired by concrete sub-trade.
      c. Inspect masonry joints to be reasonably flush and completely filled, and ensure all excess mortar sitting on masonry ties has been removed. Inform Contractor if masonry joints are not acceptable to be repaired by mason sub-trade.
   5. Notify A/E in writing of anticipated problems using boardstock air barrier over substrate prior to proceeding.
   6. Verify sealants are compatible with boardstock air barrier material proposed for use.

3.2 PREPARATION

A. Clean substrate surfaces to remove moisture, dirt, dust, grease, oil, loose material, or other matter which may affect bond of foam sealant or air seal material.
   1. Ensure surfaces are dry before proceeding with installation.
   2. Prepare surfaces by brushing, scrubbing, scraping, grinding, or compressed air to removal loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants.
   3. Wipe down metal surfaces to remove release agents or other noncompatible coatings using clean sponges or with a material chemically compatible with the primary air material.

B. Remove incompatible materials which may affect bond.

C. Install backing and damming materials for air seal to arrest liquid material leakage and support.

D. Mask, using masking tape, where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces. Remove tape as soon as possible without disturbing air seal or air seal with substrates.

3.3 INSTALLATION

A. General: Installation Instructions for Boardstock Air Barrier – Rigid Cellular Thermal Insulation Board: Install boardstock air barrier in a way that provides continuity throughout building envelope. Install materials in accordance with manufacturer's recommendations.

B. Provide continuity with air barrier systems be sealing following areas with construction and construction assemblies. These areas are typical in nature and do not limit application of these products to those noted areas, but any and all details within construction that present similar air leakage characteristics should receive similar applications. Note following:
   1. Window head, jamb, and sill areas.
   2. Junction of roof air/vapor barrier and wall air/vapor barrier.
   3. Floor-to-floor construction.
   4. Glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings.

C. Inspect roof perimeter for air leakage paths such as fluted deck itself, truss and structural beam penetrations above and below top of wall. Use smoke tester kits to identify and locate leakage.
   1. Use both one-component and two-component foam sealants in combination to create a continuous foamed-in-place seal between wall and roof air/vapor barrier.
   2. Where deck flutes run perpendicular to wall, foam open flutes completely out to fascia.
   3. Where closed flutes occur, punch flutes and inject foam through holes. Locate holes as close to wall as possible so that plane of injected and cured foam within closed flute is level with plane of exposed foam in open flutes.
   4. Where steel deck is parallel to wall, fill void with either one-component and two-component material, depending on gap size.

D. Flashing and Sealant
   1. Apply material within application limits of product manufacturer.
   2. Do not apply product on surfaces with standing water or frost.
   3. Avoid installing on days with a high probability of significant rainfall.
   4. Seal gaps greater than 1/4 inch in width with penetration filler prior to applying flashing.
      a. If facer on board insulation is damaged, make note of affected area and apply additional spray over damaged area.
      b. Replace damaged insulation, or repair facer flows with appropriate flashing as recommended by insulation manufacturer.
   5. Apply flashing and sealant to board joints, penetrations and other fenestration openings as required at material required application thickness.
      a. Apply flashing 3 inches, plus or minus 1 inch wide over board insulation joints, with at least 1 inch of spray covers each side of joint.
      b. Apply flashing and fasteners and washers along board insulation joints.
      c. Install façade attachment system after flashing has been applied.

6. Rough Openings: Apply flashing and sealant at least 3 inches onto face of insulation panel sheathing, and completely cover edge of insulation board; also spray at least 3 inch back onto rough opening substrate.
    a. It is recommended to cover back into rough opening at least 1 inch past the interior weatherseal.
7. Board Insulation or Substrate Penetrations: Apply flashing and sealant at least 2 inches onto face of insulation sheathing and at least 2 inches onto penetration or primary flashing substrate.
8. Use wet mil thickness gauge to ensure proper installation thickness.
    a. Where consistently below minimum thickness, apply another layer to achieve proper thickness requirements.
9. Visually inspect for any areas missed and trowel on sealant as necessary.

3.4 INSTALLATION OF THERMAL AND AIR BARRIER AT COLD-FORMED METAL FRAMING

A. Insulation Installation (Polyisocyanurate Foam Board)
1. Install insulation in accordance with manufacturer's recommendations. Fasten to exterior face of exterior metal stud wall framing using sheathing manufacturer's recommended type and length screw fasteners and washers. Abut panels tightly together and around openings and penetrations.
    a. Install sheathing panels horizontally with blue aluminum facing to exterior. Use maximum lengths to minimize number of joints. Locate edge joints parallel to and on framing. Center end joints over supports and stagger in each course. Provide additional framing wherever panel joints do not bear against framing, plates or sill members.
    b. Fasten panels to each support with fasteners spaced 12 inches on center at perimeter and 16 inches on center in panel field. Set back perimeter fasteners 3/8 inch from edges and ends of panel units. Drive fasteners to bear tight and flush with surface of installation. Do not countersink. Perimeter fasteners can be detailed to bridge gap of abutting board joints due to 1.75 inch diameter washer used to fasten board to studs. Maximum of two board joints may be bridged per fastener. Install flashing joint tape at end and edge joints with sufficient hand pressure to ensure seal and in accordance with sheathing manufacturer's joint sealing recommendations.
    c. Install flashing tape behind wall tie and mechanical fastening assemblies for rain screen claddings.
    d. Seal sheathing joints and penetrations of sheathing in accordance with sheathing manufacturer's joint and penetration sealing recommendations.
    e. After base flashing, which may include a termination bar running horizontally along top edge of flashing, is installed on exterior of insulated sheathing, install WEATERMATE Flashing 6 inch or 9 inch, with butyl rubber adhesive to exterior sheathing and lapped over top edge of base flashing.
    f. Install self-adhered flashing or sealant tape in a shingle fashion over all joints. Overlap the joints in the tape by the width of the tape (i.e. 4 inch tape is overlapped 4 inch).
    g. Repair all damage to boardstock air barrier. If the repair if large, cut out a section of the boardstock air barrier the width of the stud spacing. Install a section of new boardstock the same size as cut out. Seal any gaps with sealant foam. Install self-adhered flashing or sealant tape in a shingle fashion over all joints. For small holes, fill the small hole first with sealant foam then cover with self-adhered flashing, or sealant tape in a shingle fashion over all joints.

3.5 INSTALLATION OF THERMAL AND AIR BARRIER AT MASONRY CAVITY WALL APPLICATIONS

A. General: Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
1. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

B. Insulation (Extruded-Polystyrene)
   1. Apply 2 inch diameter daubs of adhesive at each of 4 corners of board with one approximately in middle (total of 5) on inside face of insulation board.
   2. Fit insulation between wall ties and other obstructions with joints staggered providing 1/4 inch to 1/2 inch spacing at end joints.
      a. Press units firmly against inside wythe of masonry or other construction.
      b. Make insulation continuous.
   3. Extend insulation of envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

C. Fill all voids between insulation boards with single component insulating foam sealant to provide continuous air and vapor barrier.

3.6 FIELD QUALITY CONTROL

A. Owner's Inspection and Testing: Cooperate with Owner's testing agency. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.
   1. Refer to Division 01 Section "Air Barrier Quality Requirements" for testing.

B. Manufacturer's Representative Inspections: Allow access to work areas and staging. Notify manufacturer in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted. Arrange for site inspections to verify conformance with Manufacturer's instructions, and this section of project specification.
   1. Inspections and testing shall be carried out by manufacture to verify conformance with manufacturer's instructions and Quality Assurance Program. Inspections shall be at 5, 50, and 95% completion with written report.

3.7 PROTECTING AND CLEANING

A. Protect air barrier materials from damage during installation and remainder of construction period, according to manufacturer's written instructions.
   1. Coordinate with installation of materials which cover air barrier assemblies, to ensure exposure period does not exceed that recommended by air barrier manufacturer.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and acceptable to primary material manufacturer.

END OF SECTION 07 27 23

SECTION 07 54 00 - THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Adhered thermoplastic membrane roofing system.
   2. Vapor retarder.
   3. Roof insulation.
   4. Cover board.
   5. Walkways.

B. Related Sections include the following:
   1. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
   2. Division 06 Section “Sheathing” for sheathing.
   3. Division 07 Section "Roofing Restoration” for restoration of existing membrane.
   4. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
   5. Division 07 Section “Roof Specialties” for roof edge terminations.
   6. Division 07 Section "Joint Sealants" for sealants not directly associated with roofing.
   7. Division 22 Section "Facility Storm Drainage Piping" for roof drains.

1.2 REFERENCES

A. American Society of Civil Engineers: Document ASCE 7, Minimum Design Loads for Buildings and Other Structures.

B. American Society of Testing and Materials (ASTM)
   1. ASTM C168 – Standard Terminology Relating to Thermal Insulation.
   2. ASTM C177 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   3. ASTM C209 – Methods of Testing Insulating Board, Structural and Decorative.
   4. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   5. ASTM C1289 – Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
   6. ASTM C1303 – Standard Test Method for Estimating the Long Term Change in the Thermal Resistance of Unfaced Closed Cell Plastic Foams by Slicing and Scaling Under Controlled Laboratory Conditions.
   7. ASTM D1079 – Standard Terminology Related to Roofing and Waterproofing.
   8. ASTM D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
   9. ASTM D2126 – Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
   10. ASTM D2842 – Standard Test Method for Water Absorption for Rigid Cellular Plastics.
   11. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
   12. ASTM E96 – Standard Test Method for Water Vapor Transmission of Materials.
   13. ASTM E108 – Standard Test Methods for Fire Tests of Roof Coverings.

C. National Roofing Contractors Association (NRCA) – Roofing and Waterproofing Manual.

D. Sheet Metal and Air Conditioning Contractors National Association, Inc., (SMACNA) – Architectural Sheet Metal Manual.

E. Underwriters Laboratories (UL) – Roofing Materials and Systems Annual Directory.

F. ANSI/SPRI WD-1: Wind Design Standard Practice for Roofing Assemblies.

G. ANSI/SPRI ES-1: Wind Design Standard for Edge Systems used with Low Slope Roofing Systems.

H. National Fire Protection Association (NFPA): NFPA 241-Safeguarding Building Construction Operations.

I. Environmental Protection Agency (EPA): EPA Method 9045.

1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

B. Positive Drainage: The drainage condition in which consideration has been made during design for all loading deflections of the deck, and additional roof slope has been provided to ensure drainage of the roof area within 48 hours of rainfall, during ambient drying conditions.

C. Roof System: A system of interacting roof components generally consisting of a membrane, roof insulation and air or vapor retarder (if present) (not including the roof deck) designed to weatherproof a structure and improve thermal resistance.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting: Conduct meeting at Project site. Comply with requirements in Division 01 Section "Project Management and Coordination." A/E will schedule and conduct meeting. Review methods and procedures related to roofing system including, but not limited to, the following:
1. Meet with Owner; A/E; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.
10. Deviations from the project specifications or the approved shop drawings are not permitted without prior written approval by roofing membrane manufacturer, the Owner, and the A/E.

B. Sequencing
1. Work shall begin only after openings and penetrations are in place and adjacent work required for a complete tie-in is in place. This includes masonry with special attention being given to roof-to-wall transitions. Work shall not begin:
   a. Before the “Preinstallation Meeting” has occurred
   b. Until conditions exist necessary for successful completion of roofing.
   c. Without presence and approval of manufacturer’s representative.
2. Prior to and during application, all dirt, devices and dust shall be removed from surfaces by vacuuming, sweeping, blowing with compressed air or similar methods.

3. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, the Applicator shall provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas.
4. After work on roof is started, no traffic will be permitted on the roof other than necessary for the roofing application and inspection. Materials shall not be piled on to the roof to the extent that design live loads are exceeded. Roofing materials shall not be transported over unfinished or finished roofing or existing roofs.
    a. Work shall begin at the furthest point from the designated spot where materials are shipped to the roof.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Submit specifications, installation instructions, and general recommendations from roofing materials manufacturer for type of roofing required. Include data substantiating that materials comply with requirements of this specification, inclusive of accelerated weathering data.
1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing, SPRI's Directory of Roof Assemblies listing, or Directory of Roof Assemblies (DORA) for assemblies.
2. Storage and handling requirements and recommendations.

B. Shop Drawings: Submit to membrane manufacturer for review and comments before issuing to A/E. Include plans, elevations, sections, details, and attachments to other Work.
1. Outline of roof and size.
2. Location and type of all penetrations.
3. Layout and thickness of insulation, fastener type and length.
4. Perimeter and penetration details, including base flashings and membrane terminations.
5. Tapered insulation, including slopes.
6. Insulation fastening patterns for corners, perimeter, and field-of-roof locations.
7. Flashing Conditions: Show all roofing conditions, include location and type of all penetrations, including but not limited to drains, perimeter conditions, roof penetration conditions, expansion joints, etc. The shop drawings must be reviewed and approved by the roof system manufacturer to assure the completed installation will meet the manufacturer's warranty requirements.
8. Wind Uplift Securement: Provide roof plan(s) marked-up to indicate extent of roof corner and roof perimeter areas, inclusive of fastener spacing/density, indicating compliance with wind uplift performance requirements. This drawing must be reviewed and approved by the roof system manufacturer to assure the completed installation will meet the manufacturer's warranty requirements and the "Performance Requirements" listed in this specification.
9. Tie-in with air barrier, where air barrier is required.

C. Samples: For the following products:
1. Walkway pads or rolls, of color required.

D. Wind Uplift Resistance Submittals: For roofing system including compliance with wind uplift performance requirements.

1.6 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Installer Qualification Data/Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system and qualifies to receive manufacturer's 20 year, no-dollar-limit warranty.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
1. Submit evidence of meeting performance requirements, including uplift resistance.

2. Submit insulation fastening patterns for corner, perimeter, and field-of-roof locations to meet performance requirements.
3. Submit an intent to warrant, executed by authorized representative of system manufacturer, indicating that manufacturer has reviewed drawings, specifications, and conditions affecting the work and, and proposes to provide warranties as referenced herein without further stipulation.
4. Submit a letter from the roof membrane manufacturer certifying the proposed roofing assembly, compatibility of materials and total R-value of insulation.

C. Sample Executable Warranty: Copy of manufacturer's warranty stating obligations, remedies, limitations, and exclusions before starting work.
1. Contractor shall submit manufacturers approved "Pre-Installation Notice" (PIN) to A/E.

D. Reports: Copy of roofing system manufacturer's inspection report of complete roof installation including any "Punch List" items.

1.7 CLOSEOUT SUBMITTALS:

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
1. Maintenance Data: For roofing system to include in maintenance manuals.
a. Roofing membrane manufacturer shall submit a Roof Maintenance and Inspection Manual with warranties and project closeout submittals. (Final payment will not be made until roof maintenance manual is submitted.)
b. Roof Maintenance and Inspection Manual shall include:
1) Cover letter recommending to the Owner that 2 roof maintenance inspections should be conducted per year.
2) Table of Contents.
3) Visual observation checklist indicating specific flashings and details to be observed. Include items such as base flashing seams, reglets and counterflashings, roof edge flashings, roof penetration flashings, roof curb flashings, boot flashings, roof drain areas, parapet wall flashings, copings, roof membrane seams, skylight flashings, etc. Applicable items shall be listed per project.
4) Copies of "Project Record" roofing details.
5) Roof plan indicating penetrations, detail locations, roof drains, and seams.
6) Final inspection report.
2. Warranties: Special executable warranties specified in this Section. When warranties are delivered to the Owner, a cover letter shall be included directing the Owner to inform (copy) the manufacturer as well as the Contractor, when reporting roofing problems, regardless of when they occurred during the warranty period, including any 'Punch List" items.
a. Contractor shall submit manufacturers approved "Pre-Installation Notice" (PIN) to A/E.
3. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.8 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer Qualifications: A qualified manufacturer that is UL listed or listed in FM Approvals' RoofNav or listed in SPRI's Directory of Roof Assemblies for roofing system identified to that used for this Project.
a. Manufacturer must be in addition to attending Pre-Installation Meeting and final inspection participants in Field Quality Control inspections to verify products are being installed as recommended. Inspections shall be schedule at critical points to verify membrane perimeter and penetrations are properly terminated per written instructions and submittal documents. Refer to "Field Quality Control" article for additional manufacturers inspections.

1) Manufacturer's inspector shall be a field technical inspector employed by the manufacturer not engaged in the sale of products. Inspector shall be experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and to determine installer's compliance with the requirements for the Project and the manufacturer's warranty certification.
2) Manufacturer's inspector services shall include examination of substrates and conditions prior to membrane installation including verification of fastening of substrate to structure. Inspections shall also include observation of membrane installation, detailing, flashing, in progress work, and complete portions of the work.
3) Manufacturer's inspector may not approve a roof installation as warrantable or acceptable if any current condition of the application of the new system does not meet the current published manufacturer's standards or submittals without review by A/E. The warrantability issue is part of the Contract Documents and does not take precedent over all contract requirements.
4) Manufacturer's inspector shall provide a written report to the A/E, roofing contractor, and CM existing conditions on day of inspection, work occurring, observation of work, workmanship and materials stored at the project site. A minimum of 5 pictures of roofing work shall be included in the reports. Reports shall be submitted within 7 days of the site visit.

2. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to install and receive a manufacturer's 20 year (or manufacturer longest period for specified product) no-dollar-limit warranty. Installer must verify this approval with a letter from manufacturer and supply letter even if a lesser warranty is specified.
   a. The Contractor shall obtain from the roofing manufacturer copies of each roof inspection and furnish a copy to the A/E. The Contractor shall inform the roofing manufacturer, with regard to warranties, that warranties shall be issued, based upon the acceptance of the roofing work, and that deficiencies noted on inspection reports have been corrected. The manufacturer shall not refuse or restrict the provisions of its warranty, based upon deficiencies noted on inspection reports, especially any report that may not have been furnished to the A/E. Inspections shall be a minimum of 3 and scheduled randomly (no prior notification) and selection of the roofing manufacturer's inspector(s) shall not be influenced by the roofing subcontractor's preferences. The A/E will not approve final payment of roofing work until final and interim inspection reports and warranty are in hand. The A/E's representative shall accompany the manufacturer's inspector and Roofing Installer during final inspection prior to issuing manufacturer's warranty.
   b. The roofing installer shall have on the job whenever roofing work is being done, a foreman/supervisor with a minimum 3 years' experience in the type of roofing specified or the roofing manufacturer's technical field representative and provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified.
3. Roofing and associated work shall be performed by a single firm called the "Installer" in this Section, so that there will be undivided responsibility for the specified performance of components parts including, but not limited to, the following (even through some parts may be subcontracted to others):
   a. Division 06 Section "Rough Carpentry": For wood insulation shops, wood nailers, and blocking required for installation of new roof and sheet metal.
   b. Division 07 Section "Sheet Metal Flashing and Trim."
   c. Division 07 Section "Roof Specialties."

B. Source Limitations: Obtain components, including roof insulation and fasteners, for membrane roofing system from or approved by roofing membrane manufacturer in writing.

C. There shall be no deviations made from this specification or shop drawing without prior written approval of the A/E. Any deviation from the manufacturer's installation procedures must be supported by a written certification on the manufacturer's letterhead and presented for the A/E's consideration.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
   1. All materials delivered from manufacturers and suppliers should be carefully inspected at the time of delivery and examined during unloading. Manufacturers' product labels should be intact. Any damaged or unsuitable material should be rejected. Material that has been exposed to weather in transit or storage should be examined carefully for deterioration and damage.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
   2. Lids should be secured on cans of stored material.
   3. Water-based materials such as asphalt emulsions, acrylic coatings and water-based adhesives should be protected from freezing.
   4. Solvents, adhesives, and sealants should be stored at proper temperature. Read instructions contained on adhesive canister for specific storage instructions.
   5. Store seam tapes and adhesives above 60 degrees F, unless otherwise recommended by manufacturer.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
   1. When moisture-sensitive materials are stored outside, they shall be placed on pallets or platforms that are raised off the ground or roof deck (at least 4 inches). Materials sensitive to moisture should be covered with water-resistant coverings that have been properly secured. Coverings that are "breathable," such as water resistant canvas tarpaulins are preferred. Factory applied shrouds used for shipping alone are not acceptable. Cover top and sides of materials and secure cover. Remove wet products from project site.
      a. During inclement seasons, or extended periods (two weeks) it is suggested that moisture sensitive materials be stored in vans or enclosed areas protected from moisture or elevated humidity.
      b. Materials determined by A/E to be damaged or to have been subjected to adverse conditions shall be removed and replaced at contractor's expense.
   2. Protect insulation against concentrated loads, and standing loads exerting a force in excess of 50 percent of the materials compressive strength.
   3. Do not expose foam core to excessive heat, sparks, or open flame.

D. Single-ply sheet materials may be stored as shipped with rolls laying horizontally or as recommended by manufacturer.
   1. When rolled materials are stored, the storage substrate should be swept to rid the surface of loose gravel, sharp objects and other debris that could damage the membrane material.
   2. Cover with tarps so moisture does not gather in the rolls. Unvented polyethylene tarpaulins are not accepted due to the accumulation of moisture beneath the tarpaulin in certain weather conditions that may affect the ease of membrane weld ability.

E. Provide continuous protection of products during delivery, storage, handling, and application.

F. Do not store roofing materials in concentrated areas of roof deck.
   1. Stored material should be raised up off the roof surface out of any standing water.

G. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.
   1. Average live loads on the roof during the work shall not exceed twenty pounds per square foot at any time.

H. All flammable materials shall be stored in a cool, dry area away from sparks and open flames. Closely follow precautions/instructions outlined on container or supplied by manufacturer/supplier.
   1. Liquid propane (LP) gas containers shall be in an upright position at all times.
      a. Comply with NFPA 58 "Standard for the Storage and Handling of Liquified Petroleum Gases" as well as appropriate publications of the National LP Gas Association.

1.10 FIELD CONDITIONS

A. Weather Condition Limitations
   1. Proceed with roofing and associated work only when weather conditions will permit unrestricted use of materials and quality control of the Work being installed, complying with the requirements and with the recommendations of the roofing materials manufacturer.
      a. Proceed only when the Installer is willing to guarantee the work as required and without additional reservations and restrictions.
   2. Apply in dry weather on a dry deck only. Where rain or inclement weather occur during application, the Work shall stop and not resume until the weather has cleared and the deck is dry.
      a. When membrane roofing materials are applied, entrapment of moisture should be prevented. Moisture in or on materials may cause membrane problems. If precipitation occurs before completely installing the roof membrane, the membrane surface in the immediate work area and the substrate should be dried or allowed to dry before work resumes.
   3. Only as much roofing as can be made weathertight each day, including all flashing and detail work, shall be installed.
      a. Uninterrupted waterstops shall be installed at the end of each day’s work and shall be completely removed before proceeding with the next day’s work. Waterstops shall not emit dangerous or unsafe fumes and shall not remain in contact with the finished roof as the installation progresses. Contaminated membrane shall be replaced at no cost to the Owner.
   4. Cold Weather
      a. When the outside temperature is below 40 deg F, certain combinations of temperature and humidity may cause condensation on the surface of solvent-based adhesives and primers. If this condition occurs, discontinue the application. When the ambient air conditions no longer cause condensation on adhesive surfaces and the membrane is clean and dry then re-apply additional adhesive or primer and proceed.
      b. The consistency of sealants, adhesives and primers will begin to thicken as the temperature drops. To minimize this, the following is recommended:
         1) Start work with sealants, adhesives and primers that have been stored between 60 and 80 deg. F. Insulated and heated boxes may be helpful.
         2) Complete test areas to determine if conditions will cause problems such as condensation with the application of the materials.
         3) Stop the operation or change to another warm container when material becomes too thick to properly apply.
      c. When the outside temperature is below 40 deg., installation of the roofing system may require additional application procedures, consult with manufacturer:

1) Ensure that the roof surface is dry. Moisture, even trace amounts, may cause poor adhesion, and may lead to moisture entrapment within the roofing system.

B. All new and temporary construction, including equipment and accessories, shall be secured in such a manner as to preclude wind blow-off and subsequent roof or equipment damage.

C. The applicator shall follow all safety regulations as required by OSHA and any other applicable authority having jurisdiction.

D. Precautions shall be taken when using adhesives at or near rooftop vents or air intakes. Coordinate the operation of vents and air intakes in such a manner as to avoid the intake of adhesive odor while ventilating the building. Keep lids on unused cans at all times.

E. Membranes are slippery when wet or covered with snow, frost, or ice. Working on surfaces under these conditions is hazardous. Appropriate safety measures must be implemented prior to working on such surfaces. Always follow OSHA and other relevant fall protection standards when working on roofs.

F. Construction Traffic: Construction site traffic from all trades should be limited to designated areas and walkways. Completed roof membranes are not suitable as work platforms or staging areas for other trades. If construction traffic is anticipated or inevitable, the use of temporary roofs can act as a sacrificial traffic surface, allowing for construction traffic and abuse until the primary weatherproofing membrane is installed.
1. Coordination between various trades is essential to avoid unnecessary rooftop traffic over completed sections of the roof and to prevent subsequent damage to the membrane roofing system.

1.11 WARRANTY

A. Special Total System Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover boards, substrate board, vapor retarder, and other components of membrane roofing system, including metal work i.e. coping and roof edge-specialties.
2. The warranty shall guarantee the roof membrane system at wind speeds up to 90 mph measured at 10 meters above ground.
3. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
4. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain components, including roof insulation and fasteners, for membrane roofing system from or approved by roofing membrane manufacturer in writing.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacturer, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
   1. Accelerated Weathering: Roofing system shall withstand 2,000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
   2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746, ASTM D 4272 or the “Resistance to Foot Traffic Test” in Section 5.5 of FM 4470.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Roofing System Design: Provide a membrane roofing system that is listed on IBC ES-Reports or is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7 and also tested in accordance with FM 4474, UL 580, or UL 1897.
   1. Fire/Windstorm Classification: Calculations shall not result in a roofing design less than FM Class 1A-90 requirements.
   2. Hail-Resistance Rating: SH.

D. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1987;
   1. Field-of-Roof Uplift Pressure (Zone 1): 33.0 lbf/sq.ft.
   2. Field-of-Roof Uplift Pressure (Zone 1): 57.4 lbf/sq.ft.
   3. Perimeter Uplift Pressure (Zone 2): 75.7 lbf/sq.ft.
   4. Corner Uplift Pressure (Zone 3): 75.7 lbf/sq.ft.

E. Polyisocyanurate Insulation
   1. Compressive Strength: 20 psi min.
   2. Dimensional Stability – maximum dimensional change after installation (inches).
      a. Length: +/- 1/8
      b. Width: +/- 1/8
      c. Thickness: +/- 1/16
      d. Squareness: 1/16
      e. Flatness: 1/16
   3. Moisture Vapor Transmission: ASTM E96, <1 perm.
   4. Water Absorption: ASTM C209, <1 percent by volume.
   5. Flame Spread: ASTM E84, <50.
   6. Service Temperature: Minus 100 degrees to 250 degrees F.
   7. Smoke Developed: ASTM E84, <450.
   8. Acidity: EPA Method 9045, 6 pH minimum, 8 pH maximum.
   9. Aged R-Value per Inch: ASTM C177 and C518, 5.6 R.

F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency, unless otherwise noted.

2.3 PVC ROOFING MEMBRANE

A. PVC Sheet: ASTM D 4434, Type III, fabric reinforced.
   1. Basis-of-Design: Duro-Tuff; Duro Last Roofing, Inc.
   2. Membrane Thickness: 60 mils.
   3. Exposed Face Color: White.

2.4 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
   1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane, unless otherwise noted.

C. Bonding Adhesive: Manufacturer's standard bonding adhesive. For application indicated.

D. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

E. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
   1. Use only where indicated. In areas where metal counterflashing or surface mounted reglets are used they must be sealed with a sealant to prevent moisture migration behind the flashing.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FM Approvals Corrosion Test, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
   1. Mixing metal types and methods of contact shall be assembled in such a manner as to avoid galvanic corrosion. Fasteners for attachment of metal to masonry shall be expansion type fasteners with stainless steel pins. All concrete fasteners and anchors shall have a minimum embedment of 1-1/4 inch and shall be approved for such use by the fastener manufacturer. All miscellaneous wood fasteners and anchors used for flashings shall have a minimum embedment of 1 inch and shall be approved for such use by the fastener manufacturer.
   2. Pullout Value: Fastener shall provide a minimum pullout of 450 pounds.
   3. Static Backout Resistance: Fastener shall provide a minimum static backout resistance of 10 inch pounds.
   4. Where fasteners will be in contact with wood treated with preservative chemicals, provide fasteners and anchorage with hot dip zinc coating of G90 complying with ASTM A153 or of Type 304 or 316 stainless steel.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.
   1. Water Cut-Off Sealant: Butyl-based, non-curing, non-hardening sealant.
      a. Manufacturers:
         1) Sikalastomer – 511; Sika Corporation.
         2) Acryl-R SM 5430; Schnee-Morehead.
         3) Rubex Non-Skinning Butyl Sealant; Edge Adhesives.
   2. Sealant: 1 or 2 component polyurethane-based sealant meeting ASTM C 920, Type S, Grade NS, Class 35, Use NT, M, A, G, and I. Manufacturer-approved primers are required. Color to match adjacent material.
      a. Manufacturers

1) MasterSeal NP 1; MBCC Group.
2) Permathane; Schnee-Morehead.
3) Sikaflex-1a; Sika Corporation.

3. Sealant Primers: Sealant primer is a quick-drying solvent-based primer for priming joints and substrates before the application of sealants.
   a. Manufacturers
      1) Sonolastic Primer 733; MBCC Group.
      2) Sikaflex Sealant/Admixture Primer; Sika Corporation.
      3) Primer; Schnee-Morehead.
4. High Temperature Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, M, G, A, and O with a service temperature up to 300 degrees F. For use in through-penetration firestops.

H. Perimeter Warning Tape/Membrane
1. Tape: Designed for use on PVC membranes as a reflective, highly visible pressure sensitive tape used to draw attention to roof perimeters and potential hazardous areas. The tape shall exceed reflectivity 3 requirements and Federal Spec L-S-300, Class 1.
2. Membrane: Compatible membrane, yellow in color.

2.5 VAPOR RETARDER

A. Laminate Sheet: Polyethylene laminate, two layers, reinforced with cord grid, with maximum permeance rating of 0.06 perm.

B. Manufacturers
1. Griffolyn Type – 65; Reef Industries.
2. DURA-SKRIM 6WW; Raven Industries.
3. WMP-VR; Lamtec Corporation.
4. PE-10; Sika-Sarnafil.

C. Auxiliary Materials
1. Tape: 4 inch wide self-adhesive pressure sensitive air barrier tape with flame spread index of 25 or less, smoke-developed index of 50 or less provided by or recommended by vapor retarder manufacturer for sealing seams and penetrations (i.e. curbs).
2. Pipe Flashings (with deck flanges): Sized to fit typical penetrations (i.e. water lines, gas lines, drain pipes, and vent pipes).
3. Butyl Tape: 1.5 inches to 2.0 inches wide 35 mil butyl tape used to seal the perimeter edge and penetrations through the air barrier.

2.6 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
1. Insulation must be manufactured by or approved in writing by membrane manufacturer for system specified. Insulation must meet requirements for manufacturers total system warranty requirements and comply with FM 4450 or UL 1256 and approved for use in FM Approvals' RoofNav listed roof assemblies or approved for use in SPRI's Directory of Roof Assemblies listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C 1289-11A, Type II, Class 2 Grade 2 min., coated polymer bonded glass fiber mat facer on both major surfaces. Facers shall be non-organic biological growth resistant. Provide Grade 3 when required by manufacturer to meet Performance and Warranty requirements.
1. (LTTR) Thermal resistance of insulation shall be calculated as 5.6 per inch.
2. Minimum total thickness, 5.2 inches, unless otherwise noted.
   a. Bottom Layer: 2 inch, minimum.
3. Size: Restrict boards installed in adhesive to 4 foot by 4 foot.

C. Tapered Insulation (Field-of-Roof): Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches, unless otherwise indicated.
   1. Material: Match roof insulation.
   2. Polyisocyanurate Insulation
      a. Minimum Thickness: 5.2 inches, unless otherwise noted.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
   1. Slope: 1/2 inch per foot, unless otherwise indicated on Drawings.

2.7 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal plates meeting corrosion-resistance provisions in FM Approvals Corrosion Test, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer. The type of fastener shall be appropriate for the substrate to achieve maximum withdraw and anti-corrosion characteristics. The membrane manufacturer approved fasteners shall also meet the following requirements:
   1. FM 4470 SPRI Corrosion Test Procedure and Guidelines for Roofing Fasteners. To pass, the fasteners shall not accumulate more than 15 percent red rust after the "required number cycles" in the Kesternich cabinet.
      a. FM and SPRI recommended number, but in no case shall it be less than 15.
   2. Pullout Value: Fastener shall provide a minimum pullout of 450 lbs.
   3. Static Backout Resistance: Fastener shall provide a minimum static backout resistance of 10-inch pounds.
   4. Steel Deck
      a. Fasteners to have self-drilling tip. Fastener tip shall be capable of cutting steel deck material of 20 gauge thickness at point of steel deck segment overlap without damage to the fastener tip.
      b. Fasteners shall be installed in high flute of metal deck with a minimum of three-quarter inch (3/4 inch) penetration. Fasteners shall not extend past the bottom of the metal deck.

C. Insulation Adhesive: Insulation manufacturer’s recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
   1. Bead-Applied Insulation Adhesive: Insulation manufacturer’s recommended bead-applied, low-rise, multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

D. Cover Board: Provide one of the following coverboards as approved by roofing manufacturer for system specified:
   1. High-Density Polyisocyanurate: ASTM C1289, Type II, Class 4, Grade 2. High-density polyisocyanurate technology bonded-in-line to mineral-surfaced, fiber glass reinforced facers with greater than 120 lbs. of compressive strength.
      a. Thickness: 1/4-inch minimum. Provide 1/2-inch thickness where required to meet assembly or warranty requirements.
         1) R-Value: 1/2 inch, R 2.5
   2. Not Acceptable: Do not substitute either cellulosic fiber (ASTM C208), Oriented Strand Board, or fiber-reinforced gypsum roof board (ASTM C1278).

E. Sprayed-Polyurethane Foam Sealant: 1 or 2 component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 16/cu.ft. density; flame spread index for 25 or less according to ASTM E 162; with primer and non-corrosive substrate cleaner, if recommended by foam sealant manufacturer.
   1. Provide single-component polyurethane sealant low-expansion sealing gaps less than 1/2 inch.
   2. Provide one component foam for voids from 1/4 to 2 inches.

3. Manufacturers
   a. Dow Chemical Company
      1) Great Stuff Pro Gaps and Cracks; gap ≤ 1/2 inch
      2) Froth Pak Foam Sealant; gap ≤ 1/2 inch
   b. Convenience Products
      1) Home Seal; gap ≤ 1/2 inch
   c. FOMO Products
      1) Extreme; gap ≤ 1/2 inch
      2) Handi Foam; gap ≤ 1/2 inch
   d. Hilti Corporation
      1) CF810; gap ≤ 1/2 inch

F. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resistant, surface-textured walkway pads or rolls, approximately 30- to 39-inches wide by at least 0.072-inchthick, and acceptable to membrane roofing system manufacturer.
   1. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
   1. Material manufacturers printed installation instructions are available for information and review.
   2. Safety precautions and safety data sheets (SDS's) are available during application.
   3. Specified materials and specified quantities, as verified by on-site inspection of product labels, are at the project site and are usually suitable for application (e.g., packaging not damaged, labels intact).
   4. Materials are stored according to the manufacturers recommendations (e.g., proper temperature, covered, off ground, on pallets).
   5. Equipment is in good working order and functioning properly.
   6. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
   7. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation and have been installed in areas to receive roofing.
   8. Verify work required for complete tie-in is in place. This includes masonry with special attention given to roof to wall transitions.
      a. Verify that all counterflashing receivers, curbs, etc., are constructed in such a manner as to provide a minimum 8 inch base flashing height measured from the finished roof's surface to the top of the base flashing membrane.
   9. Verify that surface plane flatness and fastening of steel roof deck comply with requirements in Division 05 Section "Steel Decking."
   10. Drainage patterns for proper roof membrane installation have been identified.
   11. Verify all surfaces are smooth and free of dirt, debris and incompatible materials and free of water, ice and snow.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Review "Performance" and "Warranty" requirements with membrane manufacturer to ensure compliance before beginning roofing work.

B. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

C. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
   1. Roof deck must be free of ponding water within 48 hours of rainfall. Use corrective measures to provide positive drainage.

D. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
   1. When completion of flashings and terminations is not completed by the end of each workday, provisions must be provided to temporarily close the membrane to prevent water infiltration. Phased roofing is not acceptable.
   2. Temporarily seal loose membrane edge down slope so that the membrane edge will not buck water. Caution must be exercised to ensure that membrane is not temporarily sealed near drains in such a way as to promote water migration below membrane.

3.3 APPLICATION, GENERAL

A. Application of the roofing products for installation shall be in accordance with the roofing material manufacturer's written instructions, for installation procedures and requirements not addressed in manufacturer's written instructions comply additional requirements of the project specifications and drawings, including recommendations of NRCA, SMACNA, including FM Approvals' RoofNav SPRI's Directory of Roof Assemblies listed assembly requirements, and FM Global Properties Loss Prevention Data Sheet 1-29. Material manufacturer's recommendations related to weather (temperature, moisture, and humidity), surface preparation, and shelf life must be observed.

B. Only install as much roofing as can be made weathertight each day, including all flashing work.
   1. Where possible, roof membrane panels shall be installed in such a manner as to create water-shedding seams.
   2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing systems at end of work day or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie into existing roofing to maintain weathertightness of transition and not to void warranty for existing roofing system.

D. Dry Surfaces: All surfaces to receive new insulation, membrane, or flashings shall be thoroughly dry.
   1. Metal deck surface to receive substrate board or insulation shall be thoroughly dry. Should surface moisture occur, the Contractor shall provide the necessary equipment to dry deck surface prior to application of roofing components.
      a. This is acceptable for metal roof deck only. Drying of roofing components including substrate board, insulation, and cover boards is not acceptable. If any of these products have moisture in them, or have had moisture on them they shall be removed and replaced.
      b. Roof decks shall be rigid, tight, dry, and clean of dust or debris. Now work shall start without testing of deck dryness at the beginning of each work day or period. It shall be the responsibility of the Contractor to maintain the deck in the proper and acceptable condition of application of the roof covering.
         1) Installer shall verify that all roof drain lines are functioning correctly (not clogged or blocked) before starting work. Applicator shall report any such blockages.

E. All new and temporary construction, including equipment and accessories, shall be secured in such a manner, at all times, as to preclude wind blow-off or wind damage.

F. Temporary water stops shall be installed at the end of each day's work, and shall be removed before proceeding with the next day's work. Temporary water stops shall be constructed to withstand protracted periods of inclement weather. Water stops shall be compatible with all materials and shall not emit dangerous or incompatible odors.

G. The Contractor is cautioned that the roof membrane may be incompatible with certain substances. Such materials shall not come into contact with the roof membrane at any time. If such contacts occur, the material shall be cut out and discarded. The Contractor shall consult material manufacturer with respect to material compatibility precautions, and recommendations.

H. If any unusual or concealed condition is discovered, stop the work and notify the A/E immediately in writing.

I. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified.

J. Quality Control (During Application) Checklist
   1. Weather and job conditions are suitable for the application.
   2. Substrate is sufficiently dry and suitably prepared to receive the insulation and roof membrane.
   3. Insulation and cover boards, if applicable, are butted together, as required, with joints staggered and offset if more than one layer is being used.
   4. Insulation is firmly attached with specified type and number of fasteners, or embedded in adhesive to substrate or underlying insulation as specified.
   5. Temporary water cut-offs are installed at the end of each day’s work as required.
   6. Membrane sheets are installed to side laps and end laps that buck water are minimized.
   7. Perimeter membrane fastening complies with specifications and manufacturers’ requirements.
   8. Membrane flashings are installed along with each day’s completed roof area.
   9. In high-traffic areas, protection board is being used over newly completed membrane.
      a. Roof is not being abused by other trades.

3.4 VAPOR-RETARDER INSTALLATION

A. Vertical control/expansion joints through parapet walls shall be sealed with butyl tape or sealant prior to installation of the vapor retarder.

B. All surfaces to receive the vapor retarder shall be dry prior to installation.

C. Loosely lay polyethylene and/or polyethylene film vapor retarder in a single layer over entire roof deck extending to roof edges and to adjacent walls.

D. Side and end lap each sheet a minimum of 2 inches and 6 inches respectively.

E. Vapor retarder shall be positively sealed at all edges, penetrations and walls utilizing manufacturer’s vapor retarder accessories.
   1. Seal laps with continuous strip of tape recommended by the air barrier manufacturer.
   2. Penetrations
      a. Round Pipes: Seal with a pre-manufactured pipe boot or butyl tape to seal to pipe.
      b. Curbs: Seal with butyl tape to seal to the side walls of the curb.
   3. Roof Drains: Seal to exterior side of drain bowl with butyl tape.
   4. Seal vapor retarder to the steel deck of roof edges with butyl tape. At edges of the deck where there are corrugations, the flutes on the top side of the roof deck shall be filled with spray foam insulation and then trimmed flush. The spray foam insulation shall provide a continuous surface where the vapor retarder can be sealed.

3.5 INSULATION INSTALLATION

A. Comply with roofing system manufacturer's written instructions for installing roof insulation, including warranty requirements for installing insulation.
   1. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
   2. Size: Restrict boards installed in adhesive to 4 foot by 4 foot.

B. Roof Insulation – General: Lay in multiple layers. Edges shall be butted to provide moderate contact but not deformed or placed in surface compression. Neatly cut and fit insulation around projections and vertical surfaces. Edges shall be mitered at ridges and elsewhere to prevent open joints or irregular surfaces. Stagger end joints not less than 12 inches in adjoining courses of base course. Stagger joints in succeeding layers with joints of layer below, stagger joints not less than 24 inches in adjacent rows.
   1. Insulation shall be installed in multiple layers except a single layer may be used for one board width, around drains, if thickness at drain is 2-1/2 inches or less.

C. Install tapered insulation under area of roofing to conform to slopes indicated. Tapered insulation combined with tapered saddles and drainage crickets shall achieve positive drainage. Tapered saddles at a 1/2 inch per foot slope shall be placed between drains, and crickets shall be placed on the up slope side of mechanical, skylight, and other curbs to provided positive drainage. Mechanical units should not restrict flow of runoff water.
   1. Refer to NRCA Roofing and Waterproofing Manual – 2011, Figure 10-7, “Guide for Crickets and Saddles” and Figure, “Guide for "Crickets.”
   2. Tapered insulation shall be installed between the bottom and top layer of flat stock insulation. This will prevent stepped transitions from occurring at the edge of tapered insulation boards.
   3. Tapered insulation should originate at the valley line/low point of the roof in lieu of the center of the roof drains. The structure often causes the roof drains to be offset from the valley line/low point of the roof. Saddles/crickets shall provide positive slope towards drains and not allow ponding to occur in valley lines.
   4. Use tapered insulation to provide a 4 by 4 foot square minimum sump centered on drains. 8 by 8 foot square sump centered on drains is preferred.
      a. 8 by 8 foot sump is preferred, where sump is not limited by penetrations.
      b. Do not field taper insulation.

D. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation or low-rise urethane adhesive.
   1. Support the two opposite sides of each board on steel deck flanges, as close as practical to the center of the flange with a minimum bearing width of 1 inch. Trim board edges if they veer off the flange center.
   2. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
   3. Fill remaining gaps around projections, penetrations, and perimeter with low-rise urethane adhesive (foam), including but not limited to:
      a. Between perimeter of insulation boards and nailers.
      b. Between nailers and vertical walls.
      c. Between penetrations and insulation boards.
      d. Between voids in insulation boards, inclusive of roof system slope transition conditions.
   4. All voids to be filled to match full thickness of insulation boards.
   5. Provide urethane foam sealant produced or acceptable to the roofing system/installation system manufacturer.

E. Installation Over Metal Decking:
   1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.
      a. Locate end joints over crests of decking.

b. Where installing insulation in two or more layers, install non-composite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
1) Trim insulation so that water flow is unrestricted.
f. Fill gaps exceeding 1/4 inch with insulation.
g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
h. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification or SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
e. Trim insulation so that water flow is unrestricted.
f. Fill gaps exceeding 1/4 inch with insulation.
g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
h. Adhere layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification or SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
1) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.
a. Trim cover board so that water flow is unrestricted.
3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification or SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3.7 ADHERED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. In addition, the corner and perimeter areas shall have enhanced fastening in accordance with FM1-29. Unroll roofing membrane and allow to relax before installing.
   1. Install sheet according to ASTM D 5036.

B. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel, A/E, and testing laboratory representative, if required.

C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply bonding adhesive to substrate at rate required by manufacturer and immediately install roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
   1. The membrane adhesive shall be installed per the membrane manufacturer's requirements. Note: Differing insulation facers require specific application methods and quantities of adhesives. Water-based adhesives should be utilized (unless cold conditions require the use of solvent-based adhesives); inclusive of manufacturer's required fasteners and additional fastener requirements as required to meet performance requirements.
      a. Conversion to the solvent-based adhesive shall be only with permission from the A/E.
      b. Bidder is cautioned to include the type of bonding adhesive that the membrane manufacturer will warrant based on the conditions under which the roof will be installed.

E. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.

F. Fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing. The roofing membrane shall be secured to nailers.
   1. Membrane shall be secured at the perimeter of each roof level, roof section, expansion joint, curb, skylight, interior wall, penthouse, etc., at any angle change which exceeds 2 inches in one horizontal foot and at all other penetrations in accordance with manufacturer’s details.
   2. Terminate membrane under a termination bar, metal fascia or coping, unless otherwise noted or approved as part of submittal process.
   3. Provide pre-molded accessories and corners, unless otherwise noted or approved as part of the submittal process.

G. Apply roofing membrane with side laps shingled with slope of roof deck where possible. Determine the direction of water drainage and the low point of the deck. The orientation of both ends and side laps shall be such that the direction of water flow (slope) changes to avoid backwater laps.
   1. Allow sufficient membrane to cover parapet walls and flashing details at roof edge.

H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

I. Install roofing membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and not to void warranty of existing roof system, if applicable.

3.8 HOT-AIR WELDING OF SEAM OVERLAPS

A. General:
   1. All seams shall be hot-air welded. All membrane to be welded shall be clean and dry.

a. All mechanics interceding to use hot-air welding equipment shall have completed a training course provided by either the membrane or welding equipment manufacturer prior to welding.

2. Hot-air welding equipment shall be allowed to warm up as directed by manufacturer prior to welding.

3. Seam overlaps shall be minimum 3 inches wide when automatic machine-welded and 4 inches wide when hand-welding, except for certain approved details.
   a. Width of membrane seams shall not be less than 1-1/2 inches regardless of seaming technique.

B. Hand-Welding
1. The back edge of the seam shall be welded with a narrow, but continuous weld to prevent loss of hot air during the final welding.
2. The nozzle shall be inserted into the seam at a 45 degree angle to the edge of the membrane. Once the proper welding temperature has been reached and the membrane begins to “flow”, the hand roller is positioned perpendicular to the nozzle and rolled lightly. For straight seams, the 1-1/2 inch wide nozzle is recommended for use. For corners and compound connections, the 3/4 inch wide nozzle shall be used.

C. Machine Welding
1. Machine welded seams are achieved by the use of approved automatic welding equipment. When using this equipment, all instructions shall be followed and local codes for electric supply, grounding and over current protection observed. Dedicated circuit house power or a dedicated portable general is recommended. No other equipment shall be operated simultaneously off the generator.
2. Metal tracks may be used over the deck membrane and under the machine welder to minimize or eliminate wrinkles.

D. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation. Sealing of seams of overlapping adjacent roof membrane sheets, or overlap seams between flashing components and roof membrane sheets must be accomplished using hot air equipment specified by the membrane manufacturer for the specific membrane type, in strict compliance with roof membrane manufacturer's requirements and specifications. Width of membrane seams shall be not less than 1.5 inches regardless of seaming technique.
1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane. Following are guidelines for seam probing to identify cold welds, voids or other deficiencies:
   a. Allow seams to cool to ambient temperature before probing after approximately 30 minutes.
      1) Seams may be probed using tools such as a cotter key extractor that has been filled down, a blunted or dull awl or any round-tipped tool. Continuous probing will tend to sharpen the tip of the probe, so blunting the tip will need to be done on a regular basis.
   b. Draw the probing tool along the edge of the seam. Apply firm pressure to the seam, but not into the bottom membrane sheet. The tool will not penetrate the edge of a properly welded seam. Seams should be the specified width and free of voids.
   c. Mark deficiencies with a water-soluble marker.
   d. Probe repaired seams after they have cooled completely. If repair is acceptable, wipe off the marker.
2. Test Cuts

a. On-site evaluation of welded seams shall be made daily by the Contractor to ensure membrane seam weld quality. One inch wide cross-section samples of welded-seams shall be taken at least three times per day. Test cuts shall be taken at each start-up of welding equipment, midpoint, and at each completion of the welding process. Correct welds display failure from shearing of the membrane prior to separation of the weld. Weld quality is essential. Adjust equipment settings as necessary to assure quality welds. Based on test cut findings, appropriate membrane seam remedies must be instituted. All membrane test cut locations shall be documented and membrane test cut samples shall be labeled and provided with the required daily construction reports.
b. Test cuts or seam samples may not represent the overall membrane seam construction. If test can or seam samples indicate defects, further sampling must be performed to establish the scope of corrective action.
c. Additional test cuts of suspect membrane seams shall be taken at the direction of the A/E or manufacturer's representative.
d. Each test cut shall be patched by Contractor at no additional cost to the Owner.

3. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
4. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.
5. Where 3 or more membrane sheets overlap, the T-joints shall be treated with a handheld hot air seaming tool, or other methods as approved by the roof membrane manufacturer to ensure continued seam integrity at this point.
6. Caution: Where solvents are used to clean membrane seams, ensure presence of adequate safety and first aid information. Instruct welding operator as to appropriate amounts of heat to be used. Excessive solvent/heat will cause damage to roof membrane and certain types of insulation material. Minimize solvent dispersion of top of roof membrane.
   a. Voltage fluctuations and climate conditions will affect the temperature of the heat welding equipment and subsequent quality of the seam. Contractor must take all necessary precautions to ensure seal quality. Contractor shall continuously monitor seam quality.

3.9 BASE FLASHING INSTALLATION

A. General: All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary flashings shall be allowed without the prior written approval of A/E and membrane manufacturer. Approval shall only be for specific locations and dates. If any water is allowed to enter under the newly completed roofing, the affected area shall be removed and replaced at the Contractor/Applicator’s expense. Flashing shall be adhered to compatible dry, smooth, and solvent-resistant surfaces. Use caution to ensure adhesive fumes are not drawn into the building.

B. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
   1. All flashing membranes should extend a minimum of 12 inches above roof level, and extend up and over top of parapet walls, unless otherwise detailed. If in question, submit in writing (RFI) to A/E and membrane manufacturer’s technical department for signed approval.

C. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

D. Flash penetrations and field-formed inside and outside corners with sheet flashing and hot-air weld into place.

E. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

F. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars, covered by counterflashing. Do not tightly butt the termination bars or cross expansion joints with a solid bar.

G. Flashing
1. Walls, Parapets, and Curbs:
a. Secure deck membrane at angle change before bonding the membrane to the vertical surface. Membrane must be fully adhered to vertical surfaces.
b. Secure flashing membrane with fasteners in horizontal rows for additional securement when flashing height exceeds 30 inches or as required by the roof membrane manufacturer.
c. All wood nailers exposed to the interior of the building shall be enclosed with 24 gauge, aluminum-zinc alloy-coated sheet steel.
2. Metal Edge Terminations: Approved by ANSI/SPRI ES-1
a. The width of the perimeter wood nailer to which the metal edge is to be secured shall extend beyond the width of the metal edge deck flange.
b. Secure the metal edge to the wood nailer as specified by the manufacturer.
c. All perimeter wood nailers shall be totally concealed by extending the deck membrane to completely cover the nailers and extend past the bottom edge of the nailers a minimum of 3/4 inch.
d. Prior to flashing, scrub the metal edge deck flange and membrane with splice cleaner to remove field contaminants.
3. Expansion Joints:
a. Secure the deck membrane on both sides of expansion joints with reinforced universal securement strip. Refer to expansion joint details for proper securement details.
4. Roof Drains:
a. During the flashing operation, drain openings shall be protected against debris, etc. Prior to roofing activities A/E and Roofing Contractor shall jointly review the roof drainage system to ensure proper drainage.
b. Provide a smooth transition from the roof surface to the drain-clamping ring. Prepare the substrate around each roof drain to avoid membrane bridging (Minimum 12 inch) at the sump area and possible distortion at the drain clamping ring.
c. The mating surfaces between the clamping ring and drain base shall be clean and have a smooth finish.
d. Located field splices at roof drains at least 6 inches outside the drain sump.
e. Cut the membrane so it extends approximately 1 inch minimum beyond the attachment points of the drain clamping ring.
1) Under no circumstances shall the hole in the membrane restrict water flow or be smaller than the drain tube.
f. The seal between the membrane and the drain base shall be provided using Water Cut-Off Mastic under compression.
g. Remove all existing flashing, cement, and lead in preparation for the membrane seal (application of Water Cut-Off Mastic).
h. All bolts and/or clamps shall be in place to provide compression on the Water Cut-Off Mastic.
i. Upon completion of roofing activities, check drain pipe to ensure that drain line is free of obstruction. Any obstructions shall be removed.
5. Vent Pipes: Refer to Division 07 Section "Roof Accessories" for preformed flashing sleeves.
a. Flash pipes with Molded Pipe Flashing where their installation is possible.
1) Use stainless steel clamps to seal at top.
b. Molded pipe flashing shall not be cut and patched; deck flanges shall not overlap or be installed over angle changes.
c. Where Molded Pipe Flashing cannot be installed, apply field fabricated pipe seals using flashing sheet.
1) Never use a wraparound detail or molded pipe flashing on a hot or warm penetration.

6. Penetration (Pipes, Conduits, etc.)
    a. Flash pipes with molded pipe flashing where their installation is possible.
        1) Use stainless steel clamps to seal at top.
        2) Mold pipe flashing shall not be cut and patched; deck flanges shall not overlap or be installed over angle changes.
        3) Where molded pipe flashing cannot be installed, apply field fabricated pipe seals using uncured flashing.
        4) Never use a wrap around detail or molded pipe flashing on a hot or warm penetration.
    b. Flexible penetration (electrical and braided cable, etc.): Pre-molded and filed-fabricated must not be installed around flexible pipes or conduits. Flexible penetrations must be installed in a sheet metal gooseneck or other boxed out structure.
    c. Penetration packets are required at the following locations:
        1) Rigid pipes with an outside diameter less than 1 inch.
        2) Clusters of pipes.
        3) Unusual shapes, e.g., structural beams, channels, or angles.
7. Mechanical Units and other Raised Curbs: Refer to Division 07 Section "Roof Accessories."
    a. Sheet metal counterflashing shall be installed to cover the top edge and overlap the upper portion of membrane base flashings unless the integral flange of the curb mounted with adequately covers the top of the membrane flashing.
        1) Provide a 4-inch coverage of roof flashings with counterflashings.
        2) Refer to Division 07 Section "Roof Accessories."

3.10 PERIMETER WARNING

A. Tape/Membrane
1. Areas of membrane where to be applied must be cleaned to a “like new” condition. Failure to properly clean the membrane will result in less than satisfactory adhesion or welding. The membrane should be cleaned as follows:
    a. New Membrane: Remove loose dirt and dust by wiping clean with water. For areas where dirt is embedded, scrub the application area with a commercial cleaner such as Simple Green, 409 or another similar all-purpose cleaner using a Scotch Brite scrubbing pad or similar product. Wash away residual cleaning material with clean water.
    b. Weathered Membrane: For older membranes or areas where there is excessive dirt buildup, use the above cleaning procedure followed by cleaning with a natural fiber rag wet with manufacturers “seam cleaner” and wipe away all residual cleaning solution and remaining dirt until membrane has a “like new” appearance.
2. After surface is clean and dry, apply:
    a. Tape: Apply tape to membrane taking care to avoid trapping air and creating blisters as tape is smoothed over with hand pressure. If a chalk line is used, be sure to keep chalk dust clear of application area. Do not use red caulk, it will stain. Do not apply tape to surface where the temperature is below 40 degrees F.
    b. Membrane: Hot air weld to the top of PVC roofing membrane in areas required.
3. Apply 6 feet from the perimeter edge.

3.11 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.
1. Install flexible walkways at the following locations:
    a. Locations indicated on Drawings.
    b. As required by roof membrane manufacturer’s warranty requirements.
2. Provide 6-inch clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer’s written instructions.

3.12 FIELD QUALITY CONTROL

A. Manufacturers Roof Inspections: Roofing Contractor shall notify roof manufacturer in writing of schedule for Work of this Section to allow sufficient time for inspecting. Do not modify details shown in the contract documents or shop drawings without consent of manufacturer's representative and A/E. Arrange for site inspections to verify conformance with written material manufacturer's instructions, submittals, and the Contract Documents including this section of the project specifications.
   1. In addition to the pre-installation meeting and final roof inspection the manufacturer shall perform inspections at the following minimum rate:
      a. Up to 10,000 sq.ft. of roof contract requires one (1) inspection.
      b. 10,000 to 35,000 sq.ft. of roof contract requires two (2) inspections.
      c. 35,001 to 75,000 sq.ft. of roof contract requires three (3) inspections.
      d. 75,001 to 125,000 sq.ft. of roof contract requires four (4) inspections.
      e. 125,001 to 200,000 sq.ft. of roof contract requires five (5) inspections.
      f. 200,001 sq.ft. and over of roof contract requires six (6) inspections.
   2. Forward written reports to A/E within 10 working days of the inspection and any testing performed.
   3. If the inspection reveals any defects, promptly remove and replace defection work at no additional cost to Owner.

B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.13 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to A/E and Owner.
   1. Protect existing membrane roofing system and new roof areas where continued construction traffic is anticipated.
      a. Lay protection sheet or mat over existing membrane then loose lay 1-inch minimum thick, polyisocyanurate insulation over sheet or mat and cover with loosely laid plywood or OSB panels.
      b. Protection sheet or mat: Provide a sacrificial layer of matching membrane sheet extending a minimum 6 inches beyond insulation in all directions or a woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

B. Limit traffic and material storage to areas of roofing that have been protected.

C. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

D. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to inspect and maintain roofing system. Refer to Division 01 Section "Demonstration and Training."

B. Demonstration and Training: Provide instruction, including but not limited to the following items:
   1. Review warranty requirements.
   2. Review Maintenance data.
   3. Review inspection procedures including:
      a. Where to look, e.g., roof access points, walkways, rooftop mechanical units, and litter.
      b. What to look for: cuts and punctures and compressed or crushed insulation.
      c. Remedial actions, emergency repair procedures.
      d. Preventative actions.

END OF SECTION 07 54 00

SECTION 07 61 00 - SHEET METAL ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following custom-fabricated sheet metal roofing:
   1. Standing-seam metal roofing.

B. Related Sections include the following:
   1. Division 05 Section "Cold-Formed Metal Framing" for secondary support framing supporting sheet metal roofing.
   2. Division 06 Section "Sheathing" for wood sheathing.
   3. Division 07 Section "Metal Plate Wall Panels" and Metal Composite Material Wall Panels" for coordination and color.
   4. Division 07 Section "Sheet Metal Flashing and Trim" for flashings and other sheet metal work not part of sheet metal roofing.
   5. Division 07 Section "Roof Specialties" for fasciae and copings not part of sheet metal roofing.
   6. Division 07 Section "Roof Accessories" for accessories on roof.
   7. Division 07 Section "Joint Sealants" for field-applied sheet metal roofing sealants.
   8. Division 10 Section "Dimensional Letters" for coordination with letter attachment.

1.2 COORDINATION

A. Coordinate sheet metal roofing with rain drainage work, flashing, trim, and construction of sheathing, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Meeting: Conduct meeting at Project site.
   1. Meet with Owner, A/E, sheet metal roofing Installer**,** sheathing Installer, and installers whose work interfaces with or affects sheet metal roofing including installers of roof accessories and roof-mounted equipment.
   2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   3. Review methods and procedures related to sheet metal roofing installation.
   4. Examine sheathing conditions for compliance with requirements, including flatness and attachment to structural members.
   5. Review structural loading limitations of sheathing during and after roofing.
   6. Review underlayment requirements.
   7. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal roofing.
   8. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
   9. Review temporary protection requirements for sheet metal roofing during and after installation.
   10. Review roof observation and repair procedures after sheet metal roofing installation.
   11. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following: Include details of construction relative to materials, dimensions of individual components and profiles, and finishes.
   1. Roofing sheet metal
   2. Underlayment materials

3. Fasteners
4. Sealant tape
5. Elastomeric sealant
6. Butyl sealant

B. Shop Drawings:
1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and panel installation layouts, expansion joint locations, points of fixity, and keyed details. Distinguish between shop and field-assembly work.
3. Details for forming sheet metal roofing, including seams and dimensions.
4. Details for joining and securing sheet metal roofing, including layout of fasteners, clips, and other attachments. Include pattern of seams.
5. Details of termination points and assemblies, including fixed points.
6. Details of expansion joints, including showing direction of expansion and contraction.
7. Details of roof penetrations.
8. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings.
9. Details of special conditions.
10. Details of connections to adjoining work.
11. Details of the following accessory items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):
    a. Flashing and trim.

C. Samples for Initial Selection: For each type of sheet metal roofing indicated with factory-applied color finishes.
1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Sheet Metal Roofing: 12 inches long by actual pan or panel width, including finished seam.
2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: 12-inch-long Samples for each type of accessory.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers at the items involved:
1. Sheet metal roofing, seam locations, and attachments.
2. Details for penetrations, including that for dimensional letters.

B. Qualification Data: For Installer and fabricator.

1.6 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
1. Warranties: Special warranties specified in this Section.
2. Maintenance Data: For metal roof panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Custom-Fabricated Sheet Metal Roofing Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate sheet metal roofing similar to that required for this Project and whose products have a record of successful in-service performance.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Build mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately first 10 panels, including attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by A/E in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal roofing materials in contact with other materials that might cause staining, denting, or other surface damage.
1. Store sheet metal roofing materials away from uncured concrete and masonry.
2. Protect stored sheet metal roofing materials from contact with water.

B. Protect strippable protective covering on sheet metal roofing from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal roofing installation.

C. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or give to Owner for replacement stock.
2. Collect scrap metal and place in designated area for recycling.

1.9 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Installer's Warranty: Roofing Installer's warranty, on warranty form at end of this Section, signed by Roofing Installer, in which Roofing Installer agrees to repair or replace components of custom-fabricated sheet metal roofing that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Structural failures.
b. Loose parts.
c. Wrinkling or buckling.
d. Failure to remain weathertight, including uncontrolled water leakage.
e. Deterioration of metals, metal finishes, and other materials beyond normal weathering, including nonuniformity of color or finish.
f. Galvanic action between sheet metal roofing and dissimilar materials.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Sheet metal roofing system, including, but not limited to, metal roof panels, cleats, anchors and fasteners, sheet metal flashing integral with sheet metal roofing, fascia panels, trim, underlayment, and accessories, shall comply with requirements without failure due to defective manufacturer, fabrication, or installation, or due to other defects in construction. Sheet metal roofing shall remain watertight.

B. Sheet Metal Roofing Standard: Comply with SMACNA’s “Architectural Sheet Metal Manual” unless more stringent requirements are specified or indicated on Drawings.

C. Wind-Uplift Resistance: Provide custom-fabricated sheet metal roofing capable of resisting the following design negative uplift pressure. Provide clips, fasteners, and clip spacings of type indicated and with capability to sustain, without failure, a load equal to 3 times the design negative uplift pressure.
1. Design Negative Uplift Pressure: As indicated on Drawings.

D. Thermal Movements: Provide sheet metal roofing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal roofing thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Water Infiltration: Provide sheet metal roofing that does not allow water infiltration to building interior, with metal flashing and connections of sheet metal roofing lapped to allow moisture to run over and off the material.

2.3 ROOFING SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
1. Surface: Smooth, flat finish.
2. Thickness: 0.040 inch, unless otherwise indicated.
3. Exposed Coil-Coated Finish:
    a. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
        1) Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
        2) Color: Refer to List of Finishes.
            a) Match adjacent wall panels.

2.4 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
   1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
   2. Low Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
   3. Products:
      a. Dri-Start "HR" High Performance Roofing Underlayment, Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.
      b. Vycor Ultra; GCP Applied Technologies, Inc.
      c. Perma-Seal PE; Henry Company.
      d. MetShield; Metal-Fab Manufacturing, LLC.
      e. WIP 300HT; TC MiraDRI.

2.5 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, [protective coatings, separators, sealants, and other miscellaneous items as required for a complete roofing system and as recommended by fabricator for sheet metal roofing.

B. Fasteners: Wood screws, annular-threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
   1. General:
      a. Exposed Fasteners: Heads matching color of sheet metal roofing, using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of roofing.
      b. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed; with hex-washer head.
      c. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

D. Elastomeric Joint Sealant: ASTM C 920, of base polymer, type, grade, class, and use classifications required to produce joints in sheet metal roofing that will remain weathertight and as recommended by roll-formed sheet metal roofing manufacturer for installation indicated.

E. Expansion-Joint Sealant: For hooked-type expansion joints, which must be free to move, provide non-setting, nonhardening, nonmigrating, heavy-bodied polyisobutylene sealant.

F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 ACCESSORIES

A. Sheet Metal Roofing Accessories: Provide components required for a complete sheet metal roofing assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of sheet metal roofing, unless otherwise indicated.

B. Flashing and Trim: Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent sheet metal roofing.

2.7 FABRICATION

A. General: Custom fabricate sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions (pan width and seam height), geometry, metal thickness, and other characteristics of installation indicated. Fabricate sheet metal roofing and accessories at the shop to greatest extent possible.

B. Standing-Seam Roofing: Form standing-seam pans with finished seam height of 1 inch.

C. Fabrication Tolerances: Fabricate sheet metal roofing that is capable of installation to tolerances specified in MCA's "Metal Roof Installation Manual".

D. Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work. Form exposed sheet metal work to fit substrates without excessive oil canning, buckling, and tool marks, true to line and levels indicated, and with exposed edges folded back to form hems.
   1. Lay out sheet metal roofing so cross seams, when required, are made in direction of flow with higher pans overlapping lower pans.
   2. Offset transverse seams from each other 12 inches minimum.
   3. Fold and cleat eaves and transverse seams in the shop.
   4. Form and fabricate sheets, seams, strips, cleats, valleys, ridges, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements shown and as required for leakproof construction.

E. Expansion Provisions: Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the work.
   1. Form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with butyl sealant concealed within joints.
   2. Use lapped expansion joints only where indicated on Drawings.

F. Sealant Joints: Where movable, non-expansion-type joints are indicated or required to produce weathertight seams, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA's "Architectural Sheet Metal Manual".

G. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturers of dissimilar metals or by fabricator.

H. Sheet Metal Accessories: Custom fabricate flashings and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.
   1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
   2. Sealed Joints: Form non expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
   3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
   4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

I. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, sheet metal roofing supports, and other conditions affecting performance of work.
1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking that types of fasteners are flush with surface, and that installation is within flatness tolerances.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering High-Temperature Sheet Underlayment:
1. Install self-adhering high-temperature sheet underlayment, wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days of installation.
8. Install self-adhering high-temperature underlayment at the following locations:
a. Over entire roof.

B. Install flashings to cover underlayment according to requirements in Division 07 Section "Sheet Metal Flashing and Trim."

3.3 INSTALLATION, GENERAL

A. General: Install sheet metal roofing to comply with details shown and recommendations in SMACNA’s “Architectural Sheet Metal Manual” that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for complete roofing system.
2. Install sheet metal roofing true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Do not field cut sheet metal roofing by torch.
5. Flash and seal sheet metal roofing with closure strips at eaves, rakes, and perimeter of all openings. Fasten with self-tapping screws.
6. Locate and space fastenings in uniform vertical and horizontal alignment. Predrill panels for fasteners.
7. Lap metal flashing over sheet metal roofing to direct moisture to run over and off roofing.
8. Do not use graphite pencils to mark metal surfaces.

B. Thermal Movement: Rigidly fasten metal roof panels to structure at only one location for each panel.
   1. Allow remainder of panel to move freely for thermal expansion and contraction.
   2. Avoid attaching accessories through roof panels in manner that inhibits thermal movement.

C. Fasteners: Use fastener sizes that penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

D. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by fabricator of sheet metal roofing or manufacturers of dissimilar metals.
   1. Coat back side of uncoated aluminum sheet metal roofing with bituminous coating where roofing will contact wood, ferrous metal, or cementitious construction.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Fascia:
   1. Align bottom of sheet metal roofing and fasten with blind rivets, bolts, or self-tapping screws.
   2. Flash and seal sheet metal roofing with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.4 CUSTOM-FABRICATED SHEET METAL ROOFING INSTALLATION

A. Fabricate and install work with lines and corners of exposed units true and accurate.
   1. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks, considering temper and reflectivity of metal.
   2. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
   3. Fold back sheet metal to form a hem on concealed side of exposed edges, unless otherwise indicated.

B. Install cleats to hold sheet metal roofing panels in position.
   1. Attach each cleat with at least two fasteners to prevent rotation.
   2. Space cleats not more than 12 inches o.c.
   3. Bend tabs over fastener head.
   4. Provide expansion type cleats for roof panels that exceed 30 feet in length.

C. Seal joints as shown and as required for leakproof construction. Provide low-slope transverse seams using cleats where backup of moisture may occur.
   1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
   2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

D. Standing-Seam Roofing:
   1. Attach standing-seam metal pans to substrate with cleats, double-nailed at 12 inches o.c.
   2. Install pans reaching from eave to ridge before moving to adjacent pans. Lock each pan to pan below with transverse seam.
      a. Where transverse joints are required stagger joints in adjacent panels not less than 48 inches o.c.
   3. Before pans are locked, apply continuous bead of sealant to top flange of lower pan.

4. Crimp standing seams by folding over twice so cleat and pan edges are completely engaged.
5. Lock each panel to panel below with sealed transverse seam.

3.5 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion.
1. Coordinate installation with flashings and other components.
2. Install components required for a complete sheet metal roofing assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
3. Install accessories integral to sheet metal roofing that are specified in Division 07 Section “Sheet Metal Flashing and Trim” to comply with that section’s requirements.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual."
1. Provide concealed fasteners where possible, and set units true to line and level as indicated.
2. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
3. Install flashing and trim as required to seal against weather and to provide finished appearance, including, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
4. Install continuous strip of self-adhering underlayment at edge of continuous flashing overlapping self-adhering underlayment where “continuous seal strip” is indicated in SMACNA’s “Architectural Sheet Metal Manual” and on drawings.
5. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
6. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
7. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
    a. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection.
    b. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal roofing within installed tolerances specified in MCA’s “Metal Roof Installation Manual”.

3.7 CLEANING

A. On completion of sheet metal roofing installation, clean finished surfaces as recommended by sheet metal roofing manufacturer.

B. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal roofing is installed unless otherwise indicated in manufacturer's written installation instructions.

B. Prohibit traffic of any kind on installed sheet metal roofing.

C. Maintain sheet metal roofing in clean condition during construction.

D. Replace sheet metal roofing components that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

3.9 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <**Insert name**> of <**Insert address**>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
1. Owner: <**Insert name of Owner.**>
2. Address: <**Insert address.**>
3. Building Name/Type: <**Insert information.**>
4. Address: <**Insert address.**>
5. Area of Work: <**Insert information.**>
6. Acceptance Date: <**Insert date.**>
7. Warranty Period: <**Insert time.**>
8. Expiration Date: <**Insert date.**>

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
    a. lightning;
    b. peak gust wind speed exceeding 80 mph (m/sec);
    c. fire;
    d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. vapor condensation on bottom of roofing; and
    g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this **<Insert day>** day of **<Insert month>**, **<Insert year>**.
1. Authorized Signature: **<Insert signature.>**
2. Name: **<Insert name.>**
3. Title: **<Insert title.>**

END OF SECTION 07 61 00

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sheet metal flashing and trim:
   1. Formed reglets and counterflashing
   2. Formed low-slope roof sheet metal fabrications

B. Contractor has option of forming reglets and counterflashing and equipment support flashing or providing prefabricated materials per Division 07 Section "Roof Specialties." Copings and roof edge flashings that terminate the roof membrane must be manufactured and meet ANSI/SPRI ES-1 Wind Design Standard for Edge Systems used with low-slope.
   1. Where manufactured systems only are specified, other field fabricated or shop/field fabricated substitutions will not be accepted, unless approved by A/E in writing.

C. Related Sections include the following:
   1. Division 04 Section "Unit Masonry" for installing through-wall flashing, reglets, and other sheet metal flashing and trim.
   2. Division 06 Section “Miscellaneous Rough Carpentry” for wood nailers, curbs, and blocking.
   3. Division 07 Section "Metal Wall Panels" for
      a. Preinstallation meeting.
      b. Factory-formed metal wall panels and flashing and trim not part of sheet metal flashing and trim.
   4. Division 07 Section “Metal Plate Wall Panels” for coordination with metal plate wall panel (option).
   5. Division 07 Section "Metal Composite Material Wall Panels" for coordination with metal-faced composite wall panels (option).
   6. Division 07 Section "Thermoplastic Membrane Roofing” for:
      a. Preinstallation meeting.
      b. Installing sheet metal flashing and trim integral with roofing membrane.
   7. Division 07 Section "Roof Specialties" for manufactured roof specialties not part of sheet metal flashing and trim.
   8. Division 07 Section "Roof Accessories" for set-on-type curbs, and other manufactured roof accessory units.
   9. Division 07 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.2 REFERENCES

A. American Society of Testing and Materials (ASTM)
   1. ASTM A 792 – Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

B. National Roofing Contractors Association (NRCA)
   1. NRCA Guidelines for Architectural Metal Flashings.

C. Sheet Metal and Air Conditioning Contractors National Association, Inc., (SMACNA).
   1. Architectural Sheet Metal Manual.

1.3 DEFINITIONS

A. Shop or Field Formed Sheet Metal: Include components that will be formed or fabricated in the field or at the fabricator’s shop. Fabrication of sheet metal flashing and trim roofing is predominantly by press brake forming.
   1. Shop or field formed roof membrane termination are not acceptable.

B. Prefabricated or Manufactured Roof Specialties: Items that will be plant manufactured ready for installation on a roof or parapet. Edge securement for low-slope roofs shall demonstrate compliance with ANSI/SPRI ES-1.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination
1. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
2. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leak-proof, secure, and noncorrosive installation.

B. Pre-installation Meeting: Conduct meeting at Project site in conjunction with roofing meeting.
1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review roof details, roof drainage, roof penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates, if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including sealants. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
1. Low-slope roof sheet metal fabrications.

B. Shop Drawings: Show layouts of sheet metal flashing and trim.
1. Including plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Identify material, thickness, weight, and finish for each item and location in Project.
4. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
5. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof penetration flashing.
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. Detail formed flashing and trim at scale of not less than 1-1/2-inches, including reglet (through wall flashing) details of corners, end dams, and other special applications.

C. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.
1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications; 12 inches long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size sample.

1.6 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Special warranty specified in this Section.
   2. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage. Do not store sheet metal flashing and trim materials in contact with other materials that cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

E. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or give to Owner for replacement stack.
   2. Collect scrap metal and place in designated area for recycling.

1.9 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer’s standard form in which manufacturer agrees to repair finish or replace manufactured roof specialties that show evidence of deterioration of factory applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 10 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Complete sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

1. Sheet metal flashing and trim used to terminate roof membrane must be provided part of Division 07 Section "Roof Specialties" and comply with roof manufacturer's "Total Warranty" requirements.
2. If there is a discrepancy between these references and the project specification or drawings, the more stringent requirements shall govern as verified by A/E.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
1. Comply with through wall flashing requirements of Brick Industry Association (BIA) "Technical Note No. 7 – Water Penetration Resistance – Design and Detail."

C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

2.2 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.3 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Stainless-Steel Sheet: ASTM A 240, Type 304, dead soft, fully annealed; with smooth, flat surface.
1. Nominal Thickness: 0.0250 inch minimum and as recommended by “SMACNA’s Architectural Sheet Metal Manual” for application indicated.
2. Surface: Smooth, flat.
3. Finish: No. 4 (fine reflective, polished directional satin).
a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
b. Polished Finishes: Grind and polish surfaces to product uniform finish, free of cross scratches.
1) Run grain of directional finishes with long dimension of each piece.
2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653, G90 coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792, Class A250 coating designation, Grade 40; pre-painted by coil-coating process to comply with ASTM A 755.
   1. Nominal Thickness: 0.034 inch or as recommended by “SMACNA’s Architectural Sheet Metal Manual” for application indicated.
   2. Surface Smooth, flat.
   3. Exposed Coil-Coated Finishes: Provide one of the following as standard with manufacturer for application indicated:
      a. Fluoropolymer 2-Coat System: AAMA 621 Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight.
      b. Color: As selected by A/E from manufacturer's full range.
      c. Concealed Finish: Pre-treat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and is recommended by manufacturer of primary sheet metal or manufactured item, unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and as recommended by manufacturer.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   2. Fasteners Series 300 stainless steel, unless otherwise noted.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

D. Elastomeric Sealant, where indicated only: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
   1. Provide where sealant is exposed, or movement exceeds butyl sealant movement capability.

E. Butyl Sealant, unless otherwise noted: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied.

F. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

G. Laminated Metal: Roof membrane manufacturer’s minimum 0.0247 inch thick (fka 25 gauge) galvanized steel with minimum 17-mil polyvinyl-chloride (PVC) coating.

H. Reglets: Unit of type, material, and profile required to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and welded corners and junctions and with interlocking counterflashing on exterior face, of same material as reglet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Cheney Flashing Company
    b. Fry Reglet Corporation
    c. Heckmann Building Products, Inc.
    d. Hohmann and Barnard, Inc.
    e. Keystone Flashing Company, Inc.
    f. Metal-Era, Inc.
    g. OMG Roofing Products; a division of OMG, Inc.
2. Material: Galvanized steel, 0.022 inch thick or stainless steel, 0.0188 inch thick.
3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
5. Accessories
    a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
    b. Counterflashing Wind-Resistant Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
6. Finish: With manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" and NRCA's "The NRCA Roofing Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
1. Shop fabricated items where practicable.
2. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
3. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
4. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:
1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on drawings.

D. Sealant Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

F. Seams
   1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant, unless otherwise recommended by sealant manufacturer for intended use.

G. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. General: Roof edge flashing and coping that terminate roof membranes shall be as specified in Division 07 Section "Roof Specialties" and not custom fabricated, unless otherwise noted and approved by A/E in writing.

B. Counterflashing: Fabricate in lengths not exceeding 12 feet designed so that it is removable. Counterflashing shall be fabricated so that 4 inches of roof membrane is covered. Counterflashing is to be notched and lapped at joints. Shop fabricate interior and exterior corners.
   1. Counterflashing: Fabricate from the following material:
      a. Stainless Steel: Minimum of 0.0187 inch thick.
      b. Pre-painted, Metallic-Coated Steel: Minimum of 0.0217 inch thick (fka 26 gauge).
   2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing louver edge.

C. Flashing Receivers: Fabricate units to provide secure interlocking of separate reglet/receivers and counterflashing pieces, and compatible with flashings indicated with mitered and welded corners and junctions. Type shall be as indicated, for reglets/receivers embedded in masonry refer to Division 04 Section “Unit Masonry”.
   1. Reglets/Receivers: Fabricate from the following material:
      a. Stainless Steel: Minimum of 0.0187 inch thick.
      b. Pre-painted, Metallic-Coated Steel: Minimum of 0.0217 inch thick (fka 26 gauge).

D. Roof-Penetration Flashing: Fabricate from the following material:
   1. Stainless Steel: Minimum of 0.0187 inch thick.
   2. Pre-painted, Metallic-Coated Steel: Minimum of 0.0276 inch thick (fka 24 gauge).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
   1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   2. Verify compliance with requirements for installation tolerances of substrates.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   2. Torch cutting of sheet metal flashing and trim is not permitted.
   3. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
   4. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of butyl sealant.
   5. Anchor sheet metal flashing and trim and other components of the work securely in place, with provisions for thermal and structural movement.

6. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
    a. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
1. Coat side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
    a. Exception: Bituminous coating is not required where stainless-steel sheet metal flashing is embedded in mortar.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
3. Use lapped expansion joints only where indicated on drawings.

D. Fasteners: Use fasteners of sizes that will penetrate wood blocking or sheathing not less than 1-1/4 inches for nails, not less than 3/4 inch for wood screws and not less than recommended by fastener manufacturer to achieve maximum pullout resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints with butyl sealant as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
    a. Embed hooked flanges of joint members not less than 1 inch into sealant.
    b. Form joints to completely conceal sealant.
    c. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way.
    d. Adjust setting proportionately for installation at higher ambient temperatures.
        1) Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements, and SMACNA's "Architectural Sheet Metal Manual" and NRCA's "The NRCA Roofing Manual."
1. Provide concealed fasteners where possible, set units true to line, and level as indicated.
2. Install work with laps, joints, and seams that will be permanently watertight.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric or butyl sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints a minimum of 4 inches.

4. Secure in a waterproof manner by means of snap-in installation and sealant or wedges and sealant, interlocking folded seam or blind rivets and sealant, or anchor and washer at 36-inchcenters.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
1. Seal with butyl sealant and clamp flashing to pipes penetrating roof except for flashing on vent piping.

3.4 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Reglets/Receivers: Installation of reglets is specified in Division 04 Section "Unit Masonry."

3.5 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING

A. Clean off excess sealant.

3.7 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed.

B. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing.

C. Maintain sheet metal flashing and trim in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following manufactured roof specialties:
   1. Copings.
   2. Edge metals.
   3. Counterflashings and reglets.

B. Contractor has option of forming reglets and counterflashing or providing prefabricated materials per Division 07 Section "Sheet Metal Flashing and Trim." Coping and roof edge flashing that terminate the roof membrane must be manufactured and meet ANSI/SPRI ES-1 Wind Design Standard for Edge Systems used with low-slope.
   1. Where manufactured systems are specified, other field fabricated or shop/field fabricated substitutions will not be accepted, unless otherwise noted or approved by A/E in writing.

C. Related Sections include the following:
   1. Division 04 Section "Unit Masonry" for installing reglets and for masonry through-wall flashing with receiver for counterflashing.
   2. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
   3. Division 06 Section "Sheathing."
   4. Division 07 Section “Metal Plate Wall Panels” for coordination with metal plate wall panel (option).
   5. Division 07 Section "Metal Composite Material Wall Panels" for coordination with metal-faced composite wall panels (option).
   6. Division 07 Section "Thermoplastic Membrane Roofing” for:
      a. Preinstallation meeting.
      b. Installing sheet metal flashing and trim integral with roofing membrane.
   7. Division 07 Section "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
   8. Division 07 Section "Roof Accessories" for set-on-type curbs and other manufactured roof accessory units.
   9. Division 07 Section "Joint Sealants" for field-applied sealants.

1.2 DEFINITIONS

A. Shop or Field Formed Sheet Metal: Includes components that will be formed or fabricated in the field or at the fabricator’s shop. Fabrication of sheet metal flashing and trim roofing is predominantly by press brake forming.
   1. Shop or field formed roof membrane termination are not acceptable.

B. Prefabricated or Manufactured Roof Specialties: Items that will be plant manufactured ready for installation on a roof or parapet. Edge securement for low-slope roofs shall demonstrate compliance with ANSI/SPRI/FM 4435/ES-1.

C. SPRI: Sheet membrane and component suppliers to the commercial roofing industry (address: 411 Waverly Oaks Road, Suite 331B, Waltham, MA 02452-8422, URL: www.spri.org, voice: 781-647-7026).

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate installation of manufactured roof specialties with roofing system, exterior wall system, air barrier, flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1. Performance Coordination: Coordinate with the work of roofing and exterior wall sections to ensure that roof specialties provide under the work of this Section meet or exceed specified roofing and exterior wall design performance requirements.
2. Verify that other trades and related work are complete before mounting coping covers.
    a. Ensure that information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
    b. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.
3. Mounting surfaces shall be straight and secure; substrates shall be of proper width.
4. Refer to the construction documents, shop drawings and manufacturer's installation instructions.
5. Coordinate installation with roof membrane manufacturer's installation instructions before starting.
6. Confirm and coordinate compatibility of materials and comply with warranty requirements of roofing system manufacturer.
7. Coordinate roof specialties layout and seams with sizes and locations of joints and seams in adjacent materials.

B. Pre-installation Meeting: Conduct meeting at Project Site in conjunction with roofing meetings.
1. Meet with Owner, A/E, Installer, and installers whose work interfaces with or affects roof specialties including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include preparation instructions and recommendations, storage and handling requirements and recommendations and installation methods.

B. Shop Drawings: For roof specialties.
1. Show layouts of manufactured roof specialties, including plans and elevations. Identify factory- vs. field-assembled work. Include the following:
    a. Indicate profile and pattern of seams and layout of fasteners, joining, supporting, and anchoring manufactured roof specialties including fasteners, clips, cleats, and attachments to adjoining work.
    b. Details for expansion and contraction, locations of expansion joints, including direction of expansion and contraction.
    c. Details of termination points and assemblies, including fixed points.
    d. Details of special conditions, including accessory locations.
    e. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.

C. Samples for Verification: For copings, reglets and counterflashings made from 12 inch lengths of full-size components including fasteners, cover joints, accessories, and attachments.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, verifying compliance of copings and roof edge flashings with performance requirements and showing compliance with ANSI/SPRI/FM 4435/ES-1.

1.6 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Warranty: Special warranty specified in this Section.
   2. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are ANSI/SPRI/FM 4435/ES-1 tested to specified design pressure.

B. Mockups: Build mockups to verify selections made under sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.
   1. Build mockup of typical roof edge as part of Integrated Exterior Mockup specified in Division 01 Section “Quality Requirements”.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless A/E specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

D. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

E. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.
   2. Separate metal waste in accordance with the Waste Management Plan and place in designated areas for recycling.

1.9 SEQUENCING

A. Ensure that information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

B. Ensure that products of this Section are supplied to affected trades in time to prevent interruption of construction progress.

C. Coordinate installation will roof membrane manufacturer’s installation instructions.

1.10 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Division 07 Section “Thermoplastic Membrane Roofing”.

B. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace manufactured roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Products: Subject to compliance with requirements, provide one of the products specified and approved by roof membrane manufacturer for “Total System Warranty”.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified and approved by roof membrane manufacturer for “Total System Warranty”.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain roof specialties approved by manufacturer providing roof-system warranty specified in Division 07.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressures:
   1. Zone 2 (roof edge perimeter, vertical load direction): 75.7 pounds per square foot.
   2. Zone 3 (roof edge corners, vertical direction): 103.2 pounds per square foot.
   3. Zone 4 (wall edge perimeter, horizontal load direction): 39.1 pounds per square foot.
   4. Zone 5 (wall edge corners, horizontal load direction): 48.2 pounds per square foot.

C. Thermal Movements: Provide manufactured roof specialties that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Water Infiltration: Provide manufactured roof specialties that do not allow water infiltration to building interior.

E. Roof Specialties: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
   1. If there is a discrepancy between these references and the project specifications and drawings, the more stringent requirements shall govern as verified by the A/E.

2.3 EXPOSED METALS

A. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304, No. 4 (fine reflective, polished directional satin) finish.

B. Pre-painted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A755. Provide one of the following base metals:
   1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
   2. Zinc-Coated Steel Sheet: ASTM A 653, G90 (Z275) coating designation, structural quality, and pre-painted by the coil-coating process to comply with ASTM A 755.
   3. Surface: Smooth, flat finish.
   4. Exposed Coil-Coated Finishes: Pre-painted by the coil-coated process to comply with ASTM A 755. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
      a. Two-Coat Fluoropolymer: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

2.4 CONCEALED METALS

A. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304.

B. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 (Z275) coating designation; structural quality.

C. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.

2.5 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items required by manufacturer for a complete installation.
   1. Sealants, inside weatherproofing system, shall comply with the testing and product requirements of the California Department of Public Health’s “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers”.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.
   1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
   2. Fasteners: Series 300 stainless steel, unless otherwise noted.

C. Gaskets: Manufacturer’s standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

E. Elastomeric Sealant where indicated only; ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
   1. Provide where sealant will be exposed, or movement exceeds butyl sealant movement capacity.

F. Butyl Sealant unless otherwise noted: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt mastic, ASTM D 1187 or SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

H. Laminated Metal: Roof membrane manufacturer's minimum 0.0247-inch thick (fka 25 gauge) galvanized steel with minimum 17-mil polyvinyl-chloride (PVC) coating.

2.6 COPINGS

A. Metal Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet, concealed anchorage, concealed splice plates with same finish as coping caps, mitered corner units, and end cap units. Splice plates shall include butyl sealant strips capable of providing a weathertight seal. Provide endwall flashing splice plates where parapet terminates into wall.
   1. Products: Approved by roof manufacturer for "Total System Warranty".
   2. Coping Caps: Snap-on, fabricated from the following exposed metal:
      a. Metallic-Coated Steel Sheet: In thickness that will satisfy calculated wind-load requirements and NRCA guidelines.
   3. Surface: Smooth, flat.
   4. Coping Cap Color: Match existing.
   5. Corners: Factory continuously welded or mechanically clinched and sealed watertight.
   6. Accessories: End wall flashing, concealed splice plates, 8-inch minimum wide, finished to match finish of coping cap with factory applied butyl sealant strips.
   7. Coping-Cap Attachment Method: Snap-on fabricated from coping-cap material.
      a. Snap-on Coping Anchor Plates: Concealed, galvanized steel sheet, 12 inches wide, 0.028 inch thick, with integral cleats.
      b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet.
   8. Fabrication: Taper coping from front to back, unless otherwise noted. Coping may be masonry attached or attached to a nailer as recommended by the roof specialty manufacturer for application indicated.

2.7 ROOF EDGE SPECIALTIES

A. General: Provide one of the following as recommended by manufacturer for transition from existing to new roof membrane or as Contractor's option at the canopy roof.

B. Metal Drip Edge: Manufactured, "L" shaped with continuous cleat with pre-slotted fastening holes. Provide matching corners and splice plates.
   1. Products: Approved by roof manufacturer for "Total System Warranty".
   2. Fabricate from the following exposed metal:
      a. Metallic-Coated Steel: Thickness as required to meet performance requirements and NRCA guidelines.
   3. Corners: Factory mitered and continuously welded or mechanically clinched and seal watertight.
   4. Accessories: Fascia extenders with continuous hold down cleats.
   5. Color: Refer to "List of Finishes.

C. Roof Edge Fascia (for Single-Ply Membrane Roofing)(Gravel Stop): Manufactured, two-piece, roof edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous formed- or extruded-aluminum anchor bar with integral drip edge cleat to engage fascia cover and secure single-ply roof membrane. Provide matching mitered and welded corner units.
   1. Products: Approved by roof manufacturer for "Total System Warranty".
   2. Fascia Cover: Fabricated from the following exposed metal:
      a. Metallic-Coated Steel Sheet: In thickness that will satisfy calculated wind-load requirements and NRCA guidelines.
   3. Surface: Smooth, flat.
   4. Fascia Cover Color: As indicated in "List of Finishes".
   5. Corners: Factory mitered and continuously welded or mechanically clinched and sealed watertight.
   6. Splice Plates: Concealed of same material, finish, and shape as fascia cover, not less than 8 inches long with butyl sealant.
   7. Receiver: Manufacturer's standard material and thickness.
   8. Fascia Accessories: Overflow scuppers or spill-out scuppers as necessary for application.
   9. Waterdam: With fascia's with formed retainer, provide a continuous galvanized steel waterdam to terminate single-ply roofing at perimeter.
      a. Continuous 24-gauge, G-90 galvanized steel.

2.8 COUNTERFLASHINGS AND REGLETS

A. Manufacturers: Subject to compliance with requirements, provide one of the following:
   1. Cheney Flashing Company.
   2. Fry Reglet Corporation.
   3. OMG Edge Systems (fka Hickman, W. P. Company).
   4. Keystone Flashing Company.
   5. Metal-Era, Inc.
   6. Castle Metal Products.
   7. Heckmann Building Products Inc.
   8. ATAS International Inc.
   9. Drexel Metals
   10. EXCEPTIONAL Metals

B. Counterflashings: Manufactured units in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings or roof membrane with joints lapped, from one of the following exposed metal in thickness indicated:
   1. Stainless Steel: 0.0187 inch thick (fka 26 gauge)
   2. Pre-painted, Metallic-Coated Steel: 0.028 inch thick (fka 24 gauge)

C. Reglets/Receivers: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashings indicated with factory-mitered and -welded corners or mechanically clinched and sealed watertight, and junctions, from one of the following exposed metal in thickness indicated:
   1. Stainless Steel: 0.0187 inch thick
   2. Pre-painted, Metallic-Coated Steel: 0.028 inch thick (fka 24 gauge)
   3. Corners: Factory mitered and continuously welded or mechanically clinched and seal watertight.

D. Types
   1. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
   2. Masonry Type: Refer to Division 04 Section "Unit Masonry Assemblies".

E. Accessories:

1. Counterflashing wind-restraint clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing louver edge.
2. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.
1. Examine walls, roof edges, and parapets for suitable conditions for manufactured roof specialties.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. If substrate preparation is the responsibility of another installer, notify A/E of unsatisfactory preparation before proceeding.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best results for the substrate under the project conditions.

C. Verify the manufacturer’s roof edge details for accuracy to fit the assembly prior to fabrication.

3.3 INSTALLATION, GENERAL

A. General: Install manufactured roof specialties according to manufacturer's written instructions. Anchor manufactured roof specialties securely in place and capable of resisting forces specified in performance requirements. Use fasteners, separators, sealants, and other miscellaneous items as required to complete manufactured roof specialty systems.
1. Remove protective vinyl film immediately before installation.
2. Install manufactured roof specialties with provisions for thermal and structural movement.
3. Torch cutting of manufactured roof specialties is not permitted.
4. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
5. Provide uniform, neat seams with minimum exposure of solder and sealant.

6. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
7. Do not use graphite pencils to mark metal surfaces.
8. Install water cut-offs, as recommended by membrane manufacturer, under the anchor bar.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum or stainless-steel manufactured roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.

C. Expansion Provisions: Provide for thermal expansion of exposed manufactured roof specialties.
1. Space movement joints at a maximum of 12 feet with no unplanned joints within 18 inches of corners or intersections.
2. When ambient temperature at time of installation is between 40- and 70-degrees Fahrenheit, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fasteners: Use fasteners of type and size recommended by manufacturer but of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws or as recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints with butyl sealant as required by manufacturer of roofing specialties.

F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 degrees Fahrenheit.

3.4 COPING INSTALLATION

A. Install coping to comply with coping manufacturer’s installation guide to meet performance requirements.
1. Review lengths of straight pieces of coping cap before cutting to avoid creating relatively short sections adjacent to full-length sections.

B. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

C. Anchor copings to resist uplift and outward forces according to performance requirements.
1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's recommended spacing to comply with “Performance Requirements”.

D. Install accessories, including but not limited to coping miters, end caps, splice plates, endwall flashing, and transitions as required for watertight installation.

3.5 ROOF EDGE FLASHING INSTALLATION

A. Install cleats and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings to resist uplift and outward forces according to performance requirements.

C. Install accessories, including but not limited to edge flashing miters, splice plates, and transitions as required for watertight installation.

3.6 COUNTERFLASHING AND REGLET INSTALLATION

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Embedded Reglets: Installation of reglets is specified in Division 04 Section “Unit Masonry”.

C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.

D. Counterflashings: Coordinate installation of counterflashings with installation of base flashings. Insert counterflashings in reglets or receivers and fit tightly to base flashings. Extend counterflashings 4 inches over base flashings. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric or butyl sealant.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films as manufactured roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

B. Replace manufactured roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 71 00

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Roof curbs.
   2. Pipe and duct support.
   3. Preformed flashing sleeves.

B. elated Sections:
   1. Division 05 Section "Structural Steel Framing" for:
      a. Supplemental roof framing supporting equipment supports.
      b. Supplemental roof framing for openings at:
         1) Roof curbs for HVAC equipment.
   2. Division 06 Section “Miscellaneous Rough Carpentry” for wood nailers.
   3. Division 07 low-slope roofing Sections for roofing accessories.
   4. Division 07 Section "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
   5. Division 07 Section "Roof Specialties" for manufactured coping and counterflashing.
   6. Division 09 Section “Exterior Painting” for field painting of roof accessories.
   7. Division 22 ("Plumbing") sections for coordinating pipe supports furnished and installed in this Section with plumbing piping furnished and installed by Plumbing Contractor.
   8. Division 23 ("HVAC") sections for roof curbs furnished and installed by HVAC Contractor for HVAC equipment.
      a. Coordinate roof curbs and equipment pipe supports furnished and installed in this Section with equipment and piping furnished and installed by HVAC Contractor.

1.2 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory indicated.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include details showing mounting type, relationships to surrounding construction.
   3. Manufacturer’s Installation Instructions: Indicate preparation, instructions, and installation requirements and rough openings.

B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work. Indicate procedures and accessories required for a complete installation. Distinguish between plant- and field-assembled work.
   1. Pipe and Duct Penetrations: Show physical size, installation, and working space required.

C. Delegated-Design Submittal: For roof curbs and duct supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
   2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
   1. Size and location of roof accessories specified in this Section.
   2. Method of attaching roof accessories to roof or building structure.
   3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
   4. Required clearances.

1.5 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

B. NRCA “Roofing and Waterproofing Manual” details for installation of units.

C. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in State where Project is located and who is experienced in providing engineering services of the type indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier’s freight bill of lading.

B. Storage:
   1. Store in accordance with manufacturer's instructions in well-ventilated area.
   2. Do not store roof accessories in contact with other materials that might cause staining, denting, or other surface damage.
   3. Store materials off ground in dry location.
   4. Store and protect roof accessories from nicks, scratched, and blemishes.

C. Handling: Exercise proper care in handling of work so as not to disrupt finished surfaces.

D. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-accessory substrates by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in other Part 2 articles.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for Architect/Engineer's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements" to design roof curb and duct supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind-Restraint Performance: As indicated on Structural Drawings.

2.3 METAL MATERIALS

A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheer complying with minimum ASTM A653, G90 coating designation or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792, Class AZ50 coating designation; structural quality.
   1. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.

C. Wood Nailers: Provide No. 2 grade Douglas Fir or Southern Yellow Pine nailers, treated wood
   1. Treatment: Use one of the following formulations of inorganic boron:
      a. Sodium-octaborate (SBX) or disodium – octaborate-tetrahydrate (DOT).
      b. Zinc borates (ZB) for treated engineered wood or wood composites during the manufacturing process.

D. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
   1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel.
   2. Fasteners for Aluminum Sheet: Series 300 stainless steel.

E. Elastomeric Sealant where indicated: ASTM C 920, elastomeric polyurethane or silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
   1. Provide where sealant is exposed or movement exceeds butyl sealant movement capacity.

F. Butyl Sealant unless otherwise noted: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

G. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
   1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
   2. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84

2.5 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units with integral spring-type vibration isolators and capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ATAS International, Inc.
      b. AES Industries, Inc.
      c. Air Balance; a division of MESTEK, Inc.
      d. Conn-Fab Sales, Inc.
      e. Curbs Plus, Inc.
      f. Custom Solution Roof and Metal Products, a division of Colony Heating
      g. Greenheck Fan Corporation
      h. KCC Manufacturing
      i. Kingspan Light + Air, LLC
      j. Lloyd Industries, Inc.
      k. LMCurbs
      l. Louvers & Dampers, Inc.; a division of Mestek, Inc.
      m. Metallic Products Corp.
      n. Pate Company (The)
      o. Plenums of Florida Incorporated
      p. RCS Fabrications, Inc.
      q. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
      r. Roof Products, Inc.
      s. Thybar Corporation
      t. Vent Products Co., Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Local Capacity: Unless otherwise noted on drawings, coordinate load capacity with information on Shop Drawings of equipment to be supported.

D. Materials: Provide one of the following as standard with manufacturer:
   1. Steel: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.052 inch thick (fka 18 gauge), minimum.
      a. Finish: Concealed.

E. Construction:
   1. Curb Profile: Manufacturer's standard compatible with roofing system.
   2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
   3. Fabricate curbs to minimum height of 12 inches above roofing surface, unless otherwise indicated.
   4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or use leveler frame.
   5. Insulation: Factory insulated with 2 inch thick, minimum, polyisocyanurate board insulation.
   6. Liner: Same material as curb, of manufacturer's standard thickness and finish.
   7. Nailer: Factory-installed wood nailer under top flange on side of curb, unless otherwise indicated, continuous around curb perimeter.
   8. Wind Resistant Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connections and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
   9. Metal Counterflashing: Manufacturer's standard removable fabricated of same metal and finish as curb.

2.6 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and slotted or perforated metal collar.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Custom Solution Roof and Metal Products; a division of Colony Heating
      b. Menzies Metal Products.
      c. Thaler Metal Industries Ltd.
   2. Metal: Aluminum sheet, 0.063 inch thick.
   3. Diameter: As indicated.
   4. Finish: Manufacturer's standard.

B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Custom Solution Roof and Metal Products, a division of Colony Heating
      b. Menzies Metal Products.
      c. Milcor Inc.; Duravent Group
      d. Thaler Metal Industries, Ltd.
   2. Metal: Aluminum sheet, 0.063 inch thick.
   3. Height: 12 inches minimum.
   4. Diameter: As indicated.
   5. Finish: Manufacturer's standard.

2.7 DUCT SUPPORTS

A. Duct Supports: Extruded-aluminum, urethane-insulated supports, 2 inches in diameter; with manufacturer's recommended hardware for mounting to structure or structural roof deck.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Thaler Metal USA Inc.
      b. Roof Products and Systems (RPS); Duravent Group
      c. MIFAB, Inc.

d. MIRO Ind.
e. PHP Systems/Design

2. Finish: Manufacturer's standard.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Verify that deck, curbs, roof membrane, base flashing, and other items effecting work of this section are in place and positioned correctly.

E. Verify tolerances and correct improper condition.

F. Identify conditions detrimental to providing proper quality and timely completions of work.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Install roof accessories according to manufacturer's written instructions.
1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks. Separate metal from incompatible metal or corrosion substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals. Coordinate installation of sealant with work of this section to ensure watertightness.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

3.3 INSTALLATION OF ROOF ACCESSORIES

A. Roof Curb Installation: Install each roof curb so top surface is level.

B. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer’s instructions.

C. Duct Support Installation: Install supports and attachments as required to properly support duct work as recommend by manufactures to support loads.

3.4 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. On completion of installation, clean exposed surfaces according to manufacturer's written instructions.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as roof accessories are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof accessories in a clean condition during construction.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

SECTION 07 91 00 – PREFORMED JOINT SEALS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes
   1. Preformed joint sealants.

B. Related Sections include the following:
   1. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
   2. Division 09 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
   3. Division 07 Section “Joint Sealants” for liquid sealants applied over preformed seals in dual seal system.
   4. Division 32 Section "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
   3. Joint-sealant formulation.
   4. Joint-sealant color.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive test performed by a qualified testing agency, indicating that sealants comply with requirements.

B. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Warranties: Special warranties specified in this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multiple-component materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

C. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Close and seal tightly all partly used sealant containers and store protected in well-ventilated, fire-safe area at moderate temperature.
   2. Place used sealant tubes and containers in areas designated for hazardous materials.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

B. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: 2 years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

C. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 PREFORMED JOINT SEALANTS

A. General: Preformed foam sealants are to be used at exterior building expansion joints up to 2 inches where 1 inch of movement is anticipated.

B. Preformed Foam Sealant: Manufacturer's standard preformed, pre-compressed, open-cell foam sealant that is manufactured from high-density urethane foam impregnated with a nondrying, water-repellent agent; is factory produced in pre-compressed sizes in roll or stick form to fit joint widths indicated; is coated on one side with a pressure-sensitive adhesive and covered with protective wrapping; develops a watertight and airtight seal when compressed to the degree specified by manufacturer; and complies with the following:
   1. Products:
      a. Emseal 25V; EMSEAL Joint Systems, Ltd.
      b. Willseal, Tremco
      c. Polytite B/Polytite Standard; Dayton Superior Specialty Chemicals.
      d. Polyseal; Sandell Manufacturing Co., Inc.
      e. Sealtite or Sealtite 50N; Schul International, Inc.
      f. EIF, EIS, or SIF; MM Systems Corp.
      g. Wake Seismic WeatherSeal; Watson Bowman Acme Corp.
      h. Iso-Flex Hydroseal; LymTal Int., Inc.
   2. Properties: Permanently elastic, mildew resistant, nonmigratory, nonstaining, and compatible with joint substrates and other joint sealants.
      a. Density: Minimum density of 10 lb./cu.ft.
      b. Movement Capacity: -25 percent/+ 25 percent.
      c. Nominal Joint Width: As indicated on Drawings.
   3. Joint Seal Color: As selected by A/E from full range of industry colors.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with preformed joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
   1. Apply joint sealants prior to applying penetrating water repellents. Joint sealants need to cure 7 days prior to application of penetrating masonry sealers.

B. Installation of Preformed, Foam Joint Seals
   1. Install each length of seal immediately after removing protective wrapping.
   2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
   3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
   4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer’s written instructions.

3.4 PROTECTION

A. Protect preformed joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion.

B. Cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 91 00

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes joint sealants for the applications indicated in the Joint-Sealant Schedule at the end of Part 3.
   1. Silicone joint sealants
   2. Urethane joint sealants
   3. Silyl-terminated polyether (STPE) joint sealants
   4. Butyl joint sealants
   5. Latex joint sealants

B. Related Sections include the following:
   1. Division 03 Section “Cast-in-Place Concrete” for sealing of joints in slabs-on-grade or below grade.
   2. Division 04 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
   3. Division 07 Section “Preformed Joint Seals” for preformed compressible foam and procured joint seals.
   4. Division 07 Section “Acoustical Joint Sealants” for sealing joints in sound rated construction.
   5. Division 08 Section "Glazing" for glazing sealants.
   6. Division 09 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
   7. Division 09 Section "Tiling" for sealing tile joints.
   8. Division 09 Section “Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.
   9. Division 32 Section "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of joint sealants with cleaning of joint sealant substrates and other operations that may impact installation or finished joint sealant work.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated, including backing materials that include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which laboratory adhesion and/or compatibility testing is required.
   6. Substrates for which use of primer is required.
   7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
   3. Joint-sealant formulation.
   4. Joint-sealant color.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
   1. Certify materials brought on site contain less than 1 percent asbestos as determined by polarized light microscopy (PLM) analysis.

1.5 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Warranties: Special warranties specified in this Section.
      a. Manufacturer's special warranties.
      b. Installer's special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's recognized and recommended installer for installation of elastomeric sealants required for this Project, as required by terms of warranty.

B. Product Testing: Test joint sealants using a qualified testing agency.
   1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
   1. Refer to Division 04 Section "Unit Masonry" for additional mockup requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multiple-component materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

C. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
   1. Close and seal tightly all partly used sealant containers and store protected in well-ventilated, fire-safe area at moderate temperature.
   2. Place used sealant tubes and containers in areas designated for hazardous materials.

1.8 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

B. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.

1.9 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: 2 years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which silicone sealant manufacturer agrees to furnish silicone joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: 5 years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Obtain joint sealants from a single manufacturer for each sealant type.

2.2 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

2.3 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Liquid-Applied Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.

D. Additional Movement Capability: Where additional movement capability is specified, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C920 for uses indicated.

E. Colors of Exposed Joint Sealants: As selected by A/E from manufacturer's full range, unless otherwise noted.
   1. Provide tintable silicones where custom silicones are indicated.

2.4 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 100/50, for Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. 790 or NS Parking Structure Sealant; DuPont Corporation.
      b. SilPruf LM SCS2700; GE Construction Sealants; Momentive Performance Materials, Inc.
      c. 301 NS, 311 NS, 890NST, or 890FTS; Pecora Corporation.
      d. Sikasil WS-290 or Sikasil 728 NS; Sika Corporation.
      e. Spectrem 1 or Spectrem 800; Tremco Incorporated.
      f. ADSEAL LM 4600 Series; ADFAST.

B. Single-Component, Nonsag, Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 50, for Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. 756 SMS, 791, 795, or 995; DuPont Corporation.
      b. SilGlaze II SCS2800, SilPruf NB SCS9000, or SilPruf SCS2000; GE Construction Sealants; Momentive Performance Materials, Inc.
      c. PCS; Pecora Corporation.
      d. Whitford Worldwide; PSI-641; Polymeric Systems, Inc.
      e. Sikasil WS-295 or Sikasil N+; Sika Corporation.
      f. Spectrem 2 or 3; Tremco Incorporated.
      g. ADSEAL Production 4580 Series; ADFAST.

C. Multiple-Component, Nonsag, Silicone Joint Sealant: ASTM C920, Type M, Grade NS, Class 50, for Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. 890FTS-TXTR; Pecora Corporation.
      b. Sikasil WS-295 FPS; Sika Corporation.
      c. Spectrem 4-TS; Tremco Incorporated.

D. Single-Component, Nonsag, Traffic-Grade, Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 100/50, for Use T.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. 790 or NS Parking Structure Sealant; DuPont Corporation.
      b. 301 NS or 311 NS; Pecora Corporation.
      c. Spectrem 800; Tremco Incorporated.
      d. SikaSil 728 NS; Sika Corporation.

E. Single-Component, Pourable, Traffic-Grade, Silicone Joint Sealant: ASTM C920, Type S, Grade P, Class 100/50, for Use T.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. 890-SL or SL Parking Structure Sealant; DuPont Corporation.
      b. 300 SL or 310 SL; Pecora Corporation.
      c. Spectrem 900 SL; Tremco Incorporated.
      d. SikaSil 728 SL; Sika Corporation.

F. Mildew-Resistant, Single-Component, Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. 786 Mildew Resistant; DuPont Corporation.
      b. Sanitary SCS1700; GE Construction Sealants; Momentive Performance Materials, Inc.
      c. Tremsil 200 Sanitary; Tremco Incorporated.
      d. 898; Pecora Corporation.
      e. White Lightning Silicone Ultra Low Odor All Purpose Sealant; Sherwin-Williams.
      f. Sikail-GP; Sika.
      g. ADSEAL KB 4800 Series; ADFAST.

2.5 URETHANE JOINT SEALANTS

A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C920, Type S, Grade NS, Class 25 or 35, for Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sonolastic NP1, Sonalastic TX1, or Sonolastic Ultra; MBCC Group.
      b. Chem-Calk GPS1, 900, 915, or 916 Textured; Bostik, Inc.
      c. Elasto-Thane 230; Pacific Polymers Division, ITW.
      d. Dynatrol I-XL; Pecora Corporation.
      e. Flexiprene 1000; Polymeric Systems, Inc., Whitford Worldwide.
      f. Sikaflex – 1A+ or Sikaflex Textured; Sika Corporation, Construction Products Division.
      g. Vulkem 116; Tremco Incorporated.
      h. EP-1000; Henkel (fka OSI).
      i. Stampede 1 Polyurethane Sealant; Sherwin-Williams.

B. Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C920. Type S, Grade NS, Class 25, for Use T.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sonolastic NP1 or Sonolastic Ultra; MBCC Group.
      b. Elasto-Thane 230; Pacific Polymers Division, ITW.
      c. Sikaflex – 1A+; Sika Corporation, Construction Products Division.
      d. Vulkem 116; Tremco Incorporated.
      e. Stampede 1 Polyurethane Sealant; Sherwin-Williams.

C. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sonolastic SL 1; MBCC Group.
      b. Chem-Calk 950; Bostik, Inc.
      c. NR-201; Pecora Corporation.
      d. Flexiprene PSI- 952; Polymeric Systems, Inc., Whitford Worldwide.
      e. Sikaflex-1CSL; Sika Corporation, Construction Products Division.
      f. Vulkem 45; Tremco Incorporated.
      g. Stampede 1SL Polyurethane Sealant; Sherwin-Williams.

D. Multi-component, Nonsag, Urethane Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.
   1. Products: Subject to compliance with requirements.
      a. Dynatrol II; Pecora Corporation.
         1) For traffic-grade applications, install per guidelines in manufacturer's technical bulletin.
      b. Dymeric 240 or Dymeric 240 FC, Tremco Incorporated.

E. Multi-component, Nonsag, Urethane Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sonolastic NP 2; MBCC Group.
      b. Chem-Calk 500; Bostik, Inc.
      c. Elasto-Thane 227 High Shore Type II, Elasto-Thane 227 R Type II or Elasto-Thane 227 Type II; Pacific Polymers Division, ITW.
      d. Dynatred; Pecora Corporation.
      e. Sikaflex – 2c NS or Sikaflex – 2c NS EZ Mix; Sika Corporation, Construction Products Division.
      f. Vulkem 227; Tremco Incorporated.

F. Multi-component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sonolastic NP 2; MBCC Group.
      b. Iso-Flex 885 SG; LymTal International, Inc.
      c. Elasto-Thane 227 High Shore Type II or Elasto-Thane 227 Type II; Pacific Polymers Division, ITW.
      d. Dynatred; Pecora Corporation.
      e. Sikaflex – 2c NS or Sikaflex – 2c NS EZ TG; Sika Corporation, Construction Products Division.
      f. Vulkem 227; Tremco Incorporated.

2.6 SILYL-TERMINATED POLYETHER (STPE) JOINT SEALANTS

A. STPE, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, silyl-terminated polyether joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. MBCC Group.
      b. GE Construction Sealants; Momentive Performance Materials, Inc.
      c. Pecora Corporation.
      d. Sherwin-Williams Company.
      e. Sika Hyflex 150LM; Sika Corporation.
      f. Dymonic FC; Tremco.
      g. ADSEAL DWSP 1940 Series; ADFAST.

2.7 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Chem-Calk 300; Bostik, Inc.
      b. BC-158; Pecora Corp.
      c. General Purpose Butyl Sealant; Tremco Incorp.
      d. B-100 Butyl Rubber Sealant; ADCO.

2.8 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF or better.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sonolac; MBCC Group.
      b. Chem-Calk 600; Bostik, Inc.
      c. AC-20+ Silicone; Pecora Corporation.
      d. SM 8200; Schnee-Morehead, Division, ITW.
      e. Tremflex 834; Tremco Incorporated.
      f. 950A Siliconized Acrylic Latex Caulk; Sherwin-Williams.
      g. Titebond Kitchen and Bath Sealant; Franklin International.
      h. ADSEAL DWM 1090; ADFAST.

B. Paintable Mildew-Resistant Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF or better.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Sonolac; MBCC Group.
      b. AC-20+Silicone; Pecora Corporation.
      c. Sherwin-Williams:
         1) Powerhouse 1110A Siliconized Acrylic Latex Sealant.
         2) White Lightning Kitchen and Bath Latex Ultra Sealant.
      d. Tremflex 834; Tremco.

2.9 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.10 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
   1. Verify that joints are ready to receive work.
   2. Verify that backing materials are compatible with sealants.
   3. Verify that backing rods are of the correct size.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

B. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean, porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
      a. Concrete.
      b. Masonry.
   3. Remove laitance and form-release agents from concrete.
   4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
      a. Metal.
      b. Glass.
      c. Glazed surfaces of ceramic tile.

C. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

D. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
   1. Mix and apply multi-component sealants in accordance with manufacturer's printed instructions.
   2. Apply joint sealants prior to applying penetrating water repellents. Joint sealants need to cure 7 days prior to application of penetrating masonry sealers.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

1. Joints or gaps that require sealant are to be filled with one of the specified sealants even though the note may read "Caulked".
2. Joints to be filled shall be thoroughly dry and free from dust, dirt, oil, and grease at the time of application of sealants.
3. Expansion and control joints in exterior walls shall have the joint filler material built into the wall, or between wall and slab, at the time of construction.
4. Masking: Metal shall be masked with masking tape, as well as other surfaces where it's required to prevent the sealant smearing the adjacent surface. Upon completion of the sealants, remove the tape.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces. Avoid "over-tooling" or "stretching" sealant material during application.
3. Dry tool only, no wet tooling permitted.
4. Provide concave joint profile per Figure 8A in ASTM C1193, unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur. Remove excess sealant using materials and methods approved by sealant manufacturer that will not damage joint substrate materials.
1. Remove masking tape immediately after tooling joint without disturbing seal.
2. Remove excess sealant from surfaces while stile uncured.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and non-traffic horizontal surfaces.
1. Joint locations such as, but not limited to:
a. Construction joints in cast-in-place concrete.
b. Expansion joints in unit masonry.
1) Provide joint sealants slightly darker than the adjacent masonry units. Provide multiple colors as may be required for match.
2) Provide sealant over expanding foam secondary sealant where a 2 inch building expansion joint is indicated.
c. Perimeter joints between masonry, concrete, and frames of doors, storefronts, louvers, and similar openings.
d. Lintels to masonry construction.
e. Butt joints between metal panels.
f. Exterior joints between dissimilar materials where the joining of the two surfaces leaves a gap between the meeting materials or components as may be dictated by various methods of construction to make building watertight.
g. Other joints as indicated on Drawings.
2. Provide one of the following acceptable sealants as approved by manufacturer for substrates and uses indicated:
a. Neutral-Curing Silicone Joint Sealant:
1) Single-Component, Nonsag: ASTM C920, Type S, Grade NS, Class 100/50, for Use NT.
2) Single-Component, Nonsag: ASTM C920, Type S, Grade NS, Class 50, for Use NT.
3) Multi-Component, Nonsag: ASTM C920, Type S, Grade NS, Class 50, for Use NT.
3. Color: Custom color to match A/E's sample of adjacent materials.

B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
1. Joint locations such as, but not limited to:
a. Isolation and contraction joints in cast-in-place concrete slabs.
b. Tile control and expansion joints.
c. Joints between different materials listed above.
d. Other joints as indicated on Drawings.
2. Provide one of the following acceptable sealants as approved by manufacturer for substrates and uses indicated:
a. Neutral-Curing Silicone Joint Sealant:
1) Single-Component, Nonsag, Traffic-Grade: ASTM C920, Type S, Grade NS, Class 100/50, for Use T.
2) Single-Component, Pourable, Traffic-Grade: ASTM C920, Type S, Grade P, Class 100/50, for Use T.
b. Urethane Sealant:
1) Single-Component, Pourable, Traffic-Grade: ASTM C920, Type S, Grade P, Class 25, for Use T.
2) Multi-Component, Nonsag, Traffic-Grade: ASTM C920, Type S, Grade P, Class 50, for Use T.
3) Multi-Component, Nonsag, Traffic-Grade: ASTM C920, Type S, Grade P, Class 25, for Use T.
3. Color: As selected by A/E from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint locations such as, but not limited to:
a. Isolation joints in cast-in-place concrete slabs.
b. Perimeter of floor slabs or concrete curbs which abut vertical surfaces.
c. Areas around all piping systems that penetrate the slab or foundation walls below grade (utility trenches, electrical conduits, plumbing penetrations, etc.).
d. Control and expansion joints in tile flooring.
e. Other joints as indicated on Drawings.

2. Provide the following acceptable sealants as approved by manufacturer for substrates and uses indicated:
    a. Neutral-Curing Silicone Joint Sealant: Single-Component, Nonsag, Traffic-Grade: ASTM C920, Type S, Grade NS, Class 100/50, for Use T.
    b. Urethane Joint Sealant:
        1) Single-Component, Pourable, Traffic-Grade: ASTM C920, Type S, Grade P, Class 25, for Use T.
        2) Multi-Component, Nonsag, Traffic-Grade: ASTM C920, Type S, Grade P, Class 50, for Use T.
        3) Multi-Component, Nonsag, Traffic-Grade: ASTM C920, Type S, Grade P, Class 25, for Use T.
3. Color: As selected by A/E from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces, subject to movement, unless otherwise noted.
1. Joint locations such as, but not limited to:
    a. Interior joints where interior partitions meet exterior walls of dissimilar materials and components.
    b. Other joints as indicated on Drawings.
2. Provide the following acceptable sealants as approved by manufacturer for substrates and uses indicated.
    a. Urethane Joint Sealant:
        1) Single-Component, Nonsag: ASTM C920, Type S, Grade NS, Class 25 or 35, for Use NT.
        2) Multi-Component, Nonsag: ASTM C920, Type M, Grade NS, Class 25, for Use NT.
    b. Silyl-Terminated Polyester
        1) Single-Component, STPE, S, NS, 50, NT.
3. Color: Custom to match A/E's sample.

E. Joint-Sealant Application: Interior joints in vertical surfaces not subject to movement.
1. Joint locations such as, but not limited to:
    a. Interior perimeter joints of exterior openings.
    b. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
    c. Interior joints between dissimilar materials where a gap is created where materials meet, unless otherwise noted.
2. Provide the following acceptable sealants as approved by manufacturer for substrates and uses indicated:
    a. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF or better.
3. Color: As selected by A/E from manufacturer's full range.

F. Joint-Sealant Application: Mildew-resistant interior joints in non-painted vertical surfaces and horizontal nontraffic surfaces.
1. Joint locations such as, but not limited to:
    a. Interior joints between plumbing fixtures and adjoining floors and counters.
    b. Joints between countertops and backsplashes.
    c. Tile control and expansion joints where indicated.
    d. Other joints as indicated on Drawings.
2. Provide the following acceptable sealants as approved by manufacturer for substrates and uses indicated:
    a. Mildew-Resistant, Single-Component, Acid-Curing, or Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
        1) For potable water storage sealant shall be certified by National Sanitation Foundation as conforming to the requirements of NSF Standard 61 – Drinking Water System Components – Health Effect.

2) For surfaces where incidental food contact may occur sealant must comply with United States Department of Agriculture (USDA) guidelines for incidental food contact with cured sealant.

3. Color: As selected by A/E from manufacturer's full range of colors.

G. Joint-Sealant Application: Mildew-resistant interior joints in painted vertical surfaces and horizontal non-traffic surfaces.

1. Joint locations such as, but not limited to:
   a. Interior joints between plumbing fixtures and adjoining painted walls.
   b. Joints where countertops or backsplashes intersect painted walls.
2. Provide the following acceptable sealants as approved by manufacturer for substrates and uses indicated:
   a. Mildew-Resistant Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF or better.
3. Color: As selected by A/E from manufacturer's full range of colors.

H. Joint-Sealant Application: Interior or exterior joints in vertical surfaces between laps in fabrications of sheet metal.

1. Provide one of the following acceptable sealants as approved by manufacturer for substrates and uses indicated:
   a. Urethane Joint Sealant:
      1) Single-Component, Nonsag: ASTM C920, Type S, Grade NS, Class 25 or 35, for Use NT.
      2) Single-Component, Nonsag, Traffic-Grade: ASTM C920, Type S, Grade NS, Class 25, for Use T.
2. Color: Not applicable.

I. Joint-Sealant Application: Exterior joints under metal thresholds and saddles, sill plates, or as bedding sealant for sheet metal flashing and frames of metal or wood.

1. Provide one of the following acceptable sealants as approved by manufacturer for substrates and use indicated.
   a. Neutral-Curing Silicone Joint Sealant:
      1) Single-Component, Nonsag: ASTM C920, Type S, Grade NS, Class 100/50, for Use NT.
      2) Single-Component, Nonsag: ASTM C920, Type S, Grade NS, Class 50, for Use NT.
      3) Multi-Component, Nonsag: ASTM C920, Type M, Grade NS, Class 50, for Use NT.
   b. Urethane Joint Sealant:
      1) Single-Component, Nonsag: ASTM C920, Type S, Grade NS, Class 25 or 35, for Use NT.
      2) Single-Component, Nonsag, Traffic-Grade: ASTM C920, Type S, Grade NS, Class 25, for Use T.
   c. Butyl-rubber based sealant.
2. Color: Not applicable.

END OF SECTION 07 92 00

07
DIVISION

SECTION 07 01 50.91 - ROOFING RESTORATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Roofing materials for roof repair work as indicated.
   1. This Work includes removal of existing roofing materials down to existing roof deck and installation and tie-in of new materials to existing after installation of new roof top equipment and additions.
   2. Flexible sheet roofing materials.

B. Related Sections:
   1. Division 00 Section “Information Available to Bidders” for existing warranty information.
   2. Division 05 Section “Structural Steel Framing” for steel reinforcements of openings.
   3. Division 06 Section “Miscellaneous Rough Carpentry”.
   4. Division 07 Section Thermoplastic Membrane Roofing” for new roof installations.
   5. Division 07 Section “Roof Accessories” for roof curbs.
   6. Division 23 – Heating, Ventilating, and Air Conditioning.
   7. Division 26 – Electrical.

1.2 REFERENCE

A. National Roofing Contractors Association (NRCA) – Roofing and Waterproofing Manual.

B. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) – Architectural Sheet Metal Manual.

C. Underwriters Laboratory (UL) – Roofing Materials and Systems Annual Directory.

D. ANSI/SPRI WD-1: Wind Design Standard Practice for Roofing Assemblies.

E. National Fire Protection Association (NFPA): NFPA 241 – Safeguarding Building Construction Operations.

1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D1079 and glossary of NRCA’s “The NRCA Roofing and Waterproofing Manual” for definition of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Install roofing materials, including flashings, to withstand thermally induced movement, and exposure to weather without failure due to defective manufacturer, fabrication, installation, or other defects in construction. Roof assembly shall remain watertight.

B. Material Compatibility: Provide roofing materials that are comparable with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

1.5 ACTION SUBMITTALS

A. Product Data: Submit product data to substantiate that the products being installed are the same as existing. Submit specifications, installation instructions, and general recommendations from roofing materials manufacturer for type of roofing required.

B. Shop Drawings: For roofing system, include details of attachments to other work.

1. Base flashings and membrane terminations.

1.6 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS:

A. Qualification Data: For installer; verifying manufacturers approves contractor for warranty work.

1.7 QUALITY ASSURANCE

A. Qualifications:
1. Roofing Contractor performing this Work shall be a currently active authorized Contractor of the roof membrane system manufacturer.
2. Contractor shall notify membrane manufacturer of all changes and revisions required to existing roof so as not to void existing warranty. Existing warranty shall remain in effect.
3. Roofing Contractor shall have a minimum of 5 years successful experience in the type of roofing system specified.
4. The Roofing Contractor shall have on the job whenever roofing work is being done, a foreman/supervisor with a minimum 3 years' experience in the type of roofing specified or the roofing manufacturer's technical field representative.

B. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer.
1. Materials not manufactured by system manufacturer must include certification of approval from manufacturer and meet all required warranty requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened containers and rolls with labels intact and legible. Materials having fire resistance classifications shall be delivered to the Project with labels attached as required. Deliver materials in sufficient quantity to allow continuity of work.

B. Product shall be stored indoors or in properly protected areas outdoors to provide continuous protection against wetting and moisture absorption. Emulsion shall be stored in temperature above 40 degrees F.
1. Materials stored outdoors shall be on raised platforms and cover top and sides with waterproofed materials properly tied down. Remove wet products from project site.
2. Handle roll goods as to prevent damage to edge or ends.
3. Provide continuous protection of products during delivery, storage, handling, and application.
4. Do not store roofing materials in concentrated areas of roof deck.

C. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
1. Collect scrap metal and place in designated area for recycling.
2. Rubber may be recycled into crumb rubber.
3. Asphalt products may be recycled into asphaltic paving mixes.

1.9 PROJECT CONDITIONS

A. Weather Condition Limitations
1. Proceed with roofing and associated work only when weather conditions will permit unrestricted use of materials and quality control of the Work being installed, complying with the requirements and with the recommendations of the roofing materials manufacturer.
a. Proceed only when the Installer is willing to guarantee the work as required and without additional reservations and restrictions.
2. Apply in dry weather on a dry deck only. Where rain or inclement weather occur during application, the Work shall stop and not resume until the weather has cleared and the deck is properly dry.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Insulation shall match existing composition and thickness. Field verify and submit data to the A/E to substantiate.
   1. Polyisocyanurate board insulation, unless otherwise noted or approved by holder of roof warranty: ASTM C 1289-11A, Type II, Class 2, Grade 2 minimum coated polymer-bonded glass fiber mat facer on both major surfaces.
      a. Insulation must be either manufactured and approved for use with system specified or endorsed by primary roofing manufacturer for existing system restoration.

B. Vapor barrier (if any) shall match existing.

2.2 FLEXIBLE SHEET ROOFING MATERIALS, GENERAL

A. Flexible sheet roofing system shall match existing material and thickness.
   1. Sheet Flashing: Manufacturer’s standard sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane, unless otherwise noted.

B. Metal flashings and flexible flashings shall be as recommended by the membrane manufacturer.

C. Bonding adhesives, splicing cement, splice cleaner, sealants, etc., shall all be as recommended by the membrane manufacturer.

2.3 ACCESSORIES

A. Fasteners: Metal fasteners and the recovery board shall be approved by the membrane manufacturer to assure that required conditions are met to provide a membrane manufacturer's roof warranty. The type of fastener shall be appropriate for the substrate to achieve maximum withdraw and anticorrosion characteristics. The membrane manufacturer approved fasteners shall also meet the following requirements.
   1. FM 4470 and SPRI's Test Procedure for Corrosion Resistance of Fasteners and Guidelines for Roofing Fasteners: To pass, the fasteners shall not accumulate more than 15 percent red rust after the "required number cycles" in the Kesternich cabinet.
      a. The required number of cycles is as currently recommended by FM and SPRI, but in no case shall it be less than 15.

B. Metal Termination Bars: Manufacturer’s standard predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
   1. Use only where indicated. In areas where metal counterflashing is used they must be sealed with a sealant to prevent moisture migration behind the flashing.

C. Miscellaneous Accessories: Provide pourable sealers, preformed cone, preformed inside and outside corner sheet flashings, termination reglets, cover strips, and other accessories are required for a complete installation.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Clean roof surface in accordance with manufacturer’s recommendations.

B. Substrate must be clean, dry and free of foreign materials such as oil, grease, and contaminants.

C. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof drain plugs when no work is taking place or when rain is forecast.

3.2 INSTALLATION, GENERAL

A. Materials shall be installed in strict accordance with manufacturer's written installation instructions.

B. Coordinate the installation of insulation, roofing membrane, and flashing so that insulation is not exposed to precipitation nor exposed overnight.

C. Existing materials, except metal flashings that have been approved for reuse, shall be legally removed and properly disposed of off the site. No burning of existing material or debris shall be allowed on the site.

3.3 THERMOPLASTIC MEMBRANE RESTORATION

A. Patching: Gather a hard or machine welder, a reliable source of power, a pressure roller and probe, and a compatible repair material. Install membrane manufacturer recommendations and warranty requirements, if applicable and the following recommended by the NRCA.
1. Thoroughly clean the surface to be welded, extending the perimeter of the patch to provide an ample work area.
2. Scrub the repair area with a solution of detergent and water.
3. Rinse thoroughly with clean water and allow the membrane to dry.
4. If the existing membrane surface is excessively contaminated, enlarge the hole and insert new patch material so that a weld can be made to the bottom side of the existing membrane.
5. Wipe the area of the defect and the underside of the patch material with a clean, absorbent cloth dampened with a solvent such as acetone or MEK.
6. Insert tip of welder into overlap area, heating and pressing the two surfaces together.
7. After the welded area has cooled, check seams for voids with rounded tip probe.
8. Where patches are made with reinforced materials, seal the seams at the outer perimeter to prevent water from wicking through the exposed edge of the reinforcement.

B. Flashing
1. Walls, Parapets, and Curbs:
   a. Secure deck membrane at angle change before bonding the membrane to the vertical surface. Membrane must be fully adhered to vertical surfaces.
   b. Secure flashing membrane with fasteners in horizontal rows for additional securement when flashing height exceeds 30 inches or as required by the roof membrane manufacturer.
   c. All wood nailers exposed to the interior of the building shall be enclosed with 24 gauge, aluminum-zinc alloy-coated sheet steel.
2. Vent Pipes: Refer to Division 07 Section "Roof Accessories" for preformed flashing sleeves.
   a. Flash pipes with Molded Pipe Flashing where their installation is possible.
      1) Use stainless steel clamps to seal at top.
   b. Molded pipe flashing shall not be cut and patched; deck flanges shall not overlap or be installed over angle changes.
   c. Where Molded Pipe Flashing cannot be installed, apply field fabricated pipe seals using flashing sheet.
      1) Never use a wraparound detail or molded pipe flashing on a hot or warm penetration.
3. Penetration (Pipes, Conduits, etc.)
   a. Flash pipes with molded pipe flashing where their installation is possible.
      1) Use stainless steel clamps to seal at top.
      2) Mold pipe flashing shall not be cut and patched; deck flanges shall not overlap or be installed over angle changes.

3) Where molded pipe flashing cannot be installed, apply field fabricated pipe seals using uncured flashing.
4) Never use a wraparound detail or molded pipe flashing on a hot or warm penetration.

b. Flexible penetration (electrical and braided cable, etc.): Pre-molded and filed-fabricated must not be installed around flexible pipes or conduits. Flexible penetrations must be installed in a sheet metal gooseneck or other boxed out structure.

c. Penetration packets are required at the following locations:
1) Rigid pipes with an outside diameter less than 1 inch.
2) Clusters of pipes.
3) Unusual shapes, e.g., structural beams, channels, or angles.

4. Mechanical Units and other Raised Curbs: Refer to Division 07 Section "Roof Accessories."

a. Sheet metal counterflashing shall be installed to cover the top edge and overlap the upper portion of membrane base flashings unless the integral flange of the curb mounted with adequately covers the top of the membrane flashing.
1) Provide a 4-inch coverage of roof flashings with counterflashings.
2) Refer to Division 07 Section "Roof Accessories."

3.4 FIELD QUALITY CONTROL

A. Upon completion of the Work and prior to final payment, the membrane manufacturer's representative, in the presence of the A/E, shall observe the work. Discrepancies shall be recorded and immediately rectified. Final payment will not be issued until the manufacturer's representative has given his approval for the Work and ascertained that existing warranties are still in effect.

3.5 CLEANING

A. Remove masking, protection, equipment, materials, and debris from the work and storage areas and leave areas in an undamaged and acceptable condition.

END OF SECTION 07 01 50.91

SECTION 07 42 13.16 - METAL PLATE WALL/SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum plate wall panels.

B. Related Sections:
1. Division 05 Section "Cold-Formed Metal Framing" for cold-formed metal framing support.
2. Division 07 Section "Metal Composite Material Wall/Soffit Panels" for metal-faced composite wall panels (option).
3. Division 07 Section “Weather Barrier” for coordination.
4. Division 07 Section Thermoplastic Membrane Roofing” for coordination.
5. Division 07 Section “Sheet Metal Roof” for coordination.
6. Division 07 Section "Sheet Metal Flashing and Trim" for field-formed flashings and other sheet metal work not part of metal wall/soffit panel assemblies.
7. Division 07 Section “Roof Specialties”.
8. Division 10 Section “Dimensional Letter Signage” for coordination and attachment.

C. Contractor Option: Note: Contractor has option of using either Division 07 Section “Metal Plate Wall/Soffit Panels” or Division 07 Section “Metal Composite Material Wall/Soffit Panels”.

1.2 DEFINITION

A. Metal Plate Wall/Soffit Panel Assembly: Metal plate wall/soffit panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight wall system.

1.3 COORDINATION

A. Coordinate metal plate wall/soffit panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Meeting: A/E will schedule and conduct meeting at Project site.
1. Meet with Owner, Architect, testing and inspecting agency representative, metal plate wall/soffit panel Installer, metal plate wall/soffit panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects panels including installers of metal roof and metal soffit.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal plate wall/soffit panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall/soffit penetrations, openings, and condition of other construction that will affect metal plate wall/soffit panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal plate wall/soffit panel assembly during and after installation.
8. Review procedures for coordinating installation of wall/soffit assembly components by multiple installers and to maintain proper air-water barrier and panel substrate performance requirements.
9. Review metal plate wall/soffit panel observation and repair procedures after installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal plate wall/soffit panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal plate wall/soffit panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish among factory-, shop-, and field-assembled work.
   1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):
      a. Flashing and trim.
      b. Anchorage systems.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
   1. Metal Plate Wall/soffit Panels: 8 inches long by actual panel width. Include fasteners, closures, and other panel accessories.
   2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
   3. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of metal plate wall/soffit panels adjacent to joint sealants.

D. Delegated-Design Submittal: For metal plate wall/soffit panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Qualification Data: For Installer and professional engineer.

B. Coordination Drawings: Exterior elevations, drawn to scale, on which following items are shown and coordinated with each other, using input from installers of items involved:
   1. Wall/soffit panels and attachments.
   2. Stud framing.
   3. Wall-mounted items including dimensional letter signage.

C. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS:

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Maintenance Data: For metal plate wall/soffit panels to include in maintenance manuals.
   2. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact joint sealants to joint-sealant manufacturers for testing indicated below:
   1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
      a. Perform tests under environmental conditions replicating those that will exist during installation.

2. Submit no fewer than nine pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule enough time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall/soffit and corner panel, as shown on Drawings; approximately one bay wide by one story high by full thickness, including insulation, supports, attachments, and accessories. Include four-way joint.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal plate wall/soffit panels, and other manufactured items so as not to be damaged or deformed. Package panels for protection during transportation and handling.

B. Unload, store, and erect metal plate wall/soffit panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal plate wall/soffit panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store panels to ensure dryness, with positive slope for drainage of water. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal plate wall/soffit panel for period of installation.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal plate wall/soffit panels to be performed according to manufacturer's written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall/soffit opening dimensions by field measurements before metal plate wall/soffit panel fabrication and indicate measurements on Shop Drawings.
1. Do not begin installation until substrates have been properly prepared.

C. Project Schedule: Provisions in project schedule must accommodate time interval between field measurements and fabrication/installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal plate wall/soffit panel assemblies that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Structural failures, including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.
2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal plate wall/soffit panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS/FABRICATORS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
    1. Products: Subject to compliance with requirements, provide one of products specified.
    2. Manufacturers: Subject to compliance with requirements, provide products by one of manufacturers specified.
    3. Basis-of-Design Product: Design for metal plate wall/soffit panels is based on product named. Subject to compliance with requirements, provide either named produce or a comparable product by one of the other manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Metal plate wall/soffit panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal plate wall/soffit panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Air Infiltration: Air leakage through assembly of not more than 0.12 cfm/sq. ft. of wall/soffit area when tested according to ASTM E 283 at the following test-pressure difference:
    1. Test-Pressure Difference: 1.57 lbf/sq. ft.

D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
    1. Test-Pressure Difference: 6.24 lbf/sq. ft. for a 15-minute duration with a water application rate of 5 gallon/ft^2/hour.

E. Structural Performance: Provide metal plate wall/soffit panel assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
    1. Wind Loads: Determine loads based on the following minimum design wind pressures:
        a. Uniform pressure of 20 lbf/sq.ft., unless otherwise indicated on Drawings.
    2. Deflection Limits: Metal plate wall/soffit panel assemblies shall withstand inward and outward wind loads with deflections no greater than L/60 of the span with no failure.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
    1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.3 PANEL MATERIALS

A. Aluminum Plate: ASTM B 209. Alloy and temper as recommended by manufacturer for application.
   1. Alloy shall be 3003-H14/3105-H14.

B. Panel Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal plate wall panels and remain weathertight; and as recommended in writing by panel manufacturer.

C. Aluminum Extrusions: Alloy 6063-T6 and/or 6061-T6.

2.4 MISCELLANEOUS METAL FRAMING

A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653, G60 (Z180) hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.

B. Cold-Rolled Furring Channels: Minimum 1/2-inch-wide flange.
   1. Nominal Thickness: As required to meet performance requirements.
   2. Depth: As indicated.
   3. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with nominal thickness of 0.040 inch.
   4. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.062-inch diameter wire, or double strand of 0.048-inch diameter wire.

C. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous metal framing members to substrates.

2.5 MISCELLANEOUS MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated.

B. Panel Fasteners: Self-tapping screws; bolts and nuts; self-locking rivets and bolts; end-welded studs; and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall/soffit panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

C. Metal Plate Wall/soffit Panel Accessories: Provide components required for a complete metal plate wall/soffit panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of panels unless otherwise indicated.

D. Flashing and Trim: Same material, finish, and color as adjacent metal plate wall/soffit panels, minimum 0.040 inch thick unless otherwise indicated.

E. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
   1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
   2. Low Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
   3. Products:
      a. Dri-Start "HR" High Performance Roofing Underlayment; Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.
      b. Vycor Ultra; GCP Applied Technologies, Inc.

c. Perma-Seal PE; Henry Company.
d. MetShield; Metal-Fab Manufacturing, LLC.
e. WIP 300HT; TC MiraDRI.

2.6 METAL PLATE WALL/SOFFIT PANELS

A. Metal Plate Wall/soffit Panels: Provide factory-formed, metal plate wall/soffit panels fabricated from single sheets of metal formed into profile for installation method indicated. Include attachment system components, panel stiffeners, and accessories required for weathertight system.
1. Basis-of-Design: Design is based on EC-150, caulked-joint route and return barrier aluminum plate wall/soffit panel system, fabricated by East Coast Metal Systems, Inc. or a comparable product by one of the following:
a. SL-1000 Sobotec Ltd.
b. Omawall PL (w/EVO): ATAS International
2. Material: Tension-leveled, smooth aluminum sheet, ASTM B 209, 0.125 inch thick.
3. Panel Depth: 2 inches.
4. Exterior Finish: Two-coat fluoropolymer.
a. Color: Refer to “List of Finishes”.

B. Attachment System Components: Formed from extruded aluminum.
1. Include manufacturers standard subgirts, perimeter extrusions, tracks, and drainage channels, panel stiffeners, panel clips, and anchor channels.
2. Alignment Pins: Stainless steel.

2.7 FABRICATION

A. General: Fabricate and finish metal plate wall/soffit panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
1. Panels to be factory fabricated in a controlled environment.
2. Panels to be tension leveled during roll forming process.
3. Panels to be produced in longest lengths possible.

B. Fabricate metal plate wall/soffit panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Metal Plate Wall/soffit Panels: Fabricate panels with panel stiffeners as required to comply with deflection limits. Weld and grind panel corners smooth. Fabricate panels to the following dimensional tolerances:
1. Length and Width: Plus, or minus 0.032 inch up to 48 inches; 0.064 inch more than 48 inches.
2. Diagonal: Plus, or minus 0.1875 inch.
3. Panel Bow: Not more than 0.2 percent of panel width or length up to 0.1875 inch maximum.
4. Thickness: Plus, or minus 0.008 inch.
5. Squareness: 0.1875-inch difference between diagonal measurements.
6. Camber: 0.032 inch.
7. Fabricate wall/soffit panels as required to maintain fabrication tolerances and to withstand design loads.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal plate wall/soffit panel manufacturer.
    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal plate wall/soffit panel manufacturer for application, but not less than thickness of metal being secured.

E. Panels, fabrication and installation shall meet the requirements of the Metal Construction Association Preformed Metal Wall Guidelines.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal plate wall/soffit panel supports, and other conditions affecting performance of the Work.
    1. Examine wall/soffit framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal plate wall/soffit panel manufacturer.

B. Examine roughing-in for components and systems penetrating metal plate wall/soffit panels to verify actual locations of penetrations relative to seam locations of panels before installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous metal plate wall/soffit panel support members and anchorage according to ASTM C 754 and panel manufacturer's written instructions.

B. Field measurements should be taken by the installer for verification of dimensional correctness in relationship to original plans, prior to providing manufacturer with a bill of material.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering High-Temperature Sheet Underlayment:
1. Install self-adhering high-temperature sheet underlayment, wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days of installation.
8. Install self-adhering high-temperature underlayment, where indicated.

3.4 METAL PLATE WALL/SOFFIT PANEL INSTALLATION

A. General: Install metal plate wall/soffit panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cutting of metal wall/soffit panels by torch is not permitted.
2. Rigidly fasten metal wall/soffit panels and allow for thermal expansion and contraction as required by the panel manufacturer. Predrill panels as required.
3. Install screw fasteners.
4. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
5. Commence metal plate wall/soffit panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
6. Shim or otherwise plumb substrates receiving metal plate wall/soffit panels.
7. Flash and seal metal plate wall/soffit panels with weather closures at perimeter of all openings. Do not begin installation until weather barrier and flashings that will be concealed by panels are installed.
8. Install flashing and trim as metal plate wall/soffit panel work proceeds.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
10. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners: Use fasteners of size and length as required for compatibility with substrate.
1. Aluminum Plate Wall/soffit Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal plate wall/soffit panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall/soffit plate panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.
1. Seal metal plate wall/soffit panel end laps with double beads of sealant, full width of panel. Seal side joints where recommended by panel manufacturer.

2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

E. Attachment System, General: Install attachment system required to support metal plate wall/soffit panels and to provide a complete weathertight wall/soffit system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

3.5 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal plate wall/soffit panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual" and NRCA Waterproofing Manual. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal plate wall/soffit panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall/soffit panel installation, including accessories.

B. Remove and replace metal wall/soffit panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.8 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal plate wall/soffit panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal plate wall/soffit panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.

B. After metal plate wall/soffit panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal plate wall/soffit panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13.16

SECTION 07 42 13.23 – METAL COMPOSITE MATERIAL WALL/SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal composite (fire resistive) material wall panels (MCM), joints, attachment system components and miscellaneous materials as appropriate for the design of the project.
   1. Contractor may provide either a watertight or rainscreen system.

B. Related Sections:
   1. Division 05 Section "Cold-Formed Metal Framing" for cold-formed metal framing supporting metal-faced composite wall/soffit panels.
   2. Division 07 Section "Metal Plate Wall/soffit Panels" for solid metal plate wall/soffit panels (option).
   3. Division 07 Section Thermoplastic Membrane Roofing" for coordination.
   4. Division 07 Section "Sheet Metal Roofing" for coordination.
   5. Division 07 Section "Sheet Metal Flashing and Trim" for field-formed flashings and other sheet metal work not part of metal wall/soffit panel assemblies.
   6. Division 07 Section "Roof Specialties".
   7. Division 10 Section "Dimensional Letter Signage" for coordination and attachment.
   8. Division 07 Section "Joint Sealants" for:
      a. Silicone adhesive to secure retaining clip to face of composite wall/soffit panel.
      b. Joint sealant between perimeter trim and surrounding materials.
   9. Division 10 Section "Dimensional Letter Signage" for coordination and attachment.

C. Contractor Option: Note: Contractor has option of using either Division 07 Section "Metal Plate Wall/soffit Panels" or Division 07 Section "Metal Composite Material Wall/soffit Panels".

1.2 DEFINITION

A. Metal-Faced Composite Wall/soffit Panel Assembly: Metal-faced composite wall/soffit panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete system.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate metal-faced composite wall/soffit panel assemblies with rain drainage work, flashing, trim, and construction of studs, sheathing, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Meeting: A/E will schedule and conduct meeting at Project site.
   1. Meet with Owner, A/E, testing and inspecting agency representative, metal-faced composite wall/soffit panel Installer, metal-faced composite wall/soffit panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal-faced composite wall/soffit panels including installers of metal roof assembly and soffits.
   2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   3. Review methods and procedures related to metal-faced composite wall/soffit panel installation, including manufacturer's written instructions.
   4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
   5. Review flashings, special siding details, wall/soffit penetrations, openings, and condition of other construction that will affect metal-faced composite wall/soffit panels.

6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal-faced composite wall/soffit panel assembly during and after installation.
8. Review wall/soffit panel observation and repair procedures after metal-faced composite wall/soffit panel installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal-faced composite wall/soffit panel and accessory.

B. Shop Drawings: Submit shop drawings showing elevations and layouts, profiles, and product components, including anchorage, accessories, finish colors, and textures.
1. Include details showing thickness and dimensions of the system parts, details of edge conditions, attachment system, corners, fastening and anchoring methods, locations of joints and gaskets, location and configuration of joints necessary to accommodate thermal movement and all trim and flashings.
2. Provide signed and sealed drawings by a qualified Design Professional in the Project jurisdiction, of the MCM System showing conformance with the performance requirements and design criteria identified for this project.
3. Accessories: Include details of following items, at a scale of not less than 1-1/2 inches per 12 inches:
   a. Flashing and trim.
   b. Anchorage systems.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Metal-Faced Composite Wall/soffit Panels: 8-inches long by actual panel width. Include fasteners, closures, and other metal-faced composite wall/soffit panel accessories.
   a. Composite Panels: Include four-way joint.

D. Delegated-Design Submittal: For metal-faced composite wall/soffit panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.
1. Show governing MCM types, mounting system including anchorages, connections, and fasteners. Indicate location, type magnitude, and direction of loads imposed on building structural frame.
2. Analysis/calculations shall be signed and sealed by a qualified Design Professional in project jurisdiction that MCM system shows conformance with performance requirements and design criteria identified for this project.

1.6 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Qualification Data: For Installer, professional engineer, and testing agency.

B. MCM Manufacturer's Material Test Reports: Certified test reports showing compliance with specified performance requirements, and a third-party listing documenting compliance to a comparable code section.

C. MCM System Fabricator's Certified System Test Reports: Certified system test reports showing system compliance with specific performance characteristics or a third-party listing documenting compliance to a comparable code section. Performance requirements shall be based on type of MCM systems provided:
1. Wet System
   a. Tested to AAMA 501 standard.
2. Pressure Equalized Rain Screen System (PER)

a. Tested to AAMA 508 standard.

D. Coordination Drawings: Exterior elevations, drawn to scale, on which following items are shown and coordinated with each other, using input from installers of items involved:
1. Wall/soffit panels and attachments.
2. Stud framing.
3. Wall-mounted items including dimensional letter signage.

E. Sample Warranty: Copy of manufacturer's warranty stating obligations.

1.7 CLOSEOUT SUBMITTALS:

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
1. Maintenance Data: For metal wall/soffit panels to include in maintenance manuals.
2. Warranties: Samples of special warranties.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
1. Installer shall have experience with similar sized MCM system projects. MCM system installer must be capable of providing field service representation during construction.
2. MCM System Installer must be approved installer by a MCM Certified Fabricator for installation of their MCM System and have undergone proper training for specified system thereof.

B. Regulatory Code Agencies Requirements: Provide composite fire rated panels which have been evaluated and are in compliance with local authorities with jurisdiction.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall/soffit and corner panel, as shown on Drawings; approximately one bay wide by one story high by full thickness, including supports, attachments, and accessories.
a. Include four-way joint for metal-faced composite wall panels.
2. Approval of mockups does not constitute approval of deviations from Contract Documents contained in mockups unless A/E specifically approves such deviations in writing.
3. Approved mockups may become part of completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal-faced composite wall/soffit panels, and other manufactured items so as not to be damaged or deformed. Package metal-faced composite wall/soffit panels for protection during transportation and handling.

B. Unload, store, and erect metal-faced composite wall/soffit panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Store metal-faced composite wall/soffit panels vertically, covered with suitable weathertight and ventilated covering. Store metal-faced composite wall/soffit panels to ensure dryness, with positive slope for drainage of water. Do not store metal-faced composite wall/soffit panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg. F.

D. Retain strippable protective covering on metal-faced composite wall/soffit panel for period of panel installation.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal-faced composite wall/soffit panels to be performed according to manufacturer's written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall/soffit opening dimensions by field measurements before metal-faced composite wall/soffit panel fabrication and indicate measurements on Shop Drawings.

C. Project Schedule: Provisions in project schedule must accommodate time interval between field measurements and fabrication/installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal-faced composite wall/soffit panel assemblies that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, following:
      a. Structural failures, including rupturing, cracking, or puncturing.
      b. Deterioration of metals and other materials beyond normal weathering.
         1) Anodized Finish: Five plus 1 years from date of shipment.
      c. MCM Material Integrity: Five (5) plus 1 years from date of shipment.
   2. Warranty Period: Two years from date of Substantial Completion, unless otherwise noted.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal-faced composite wall/soffit panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Metal-faced composite wall/soffit panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal-faced composite wall/soffit panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Performance: Provide metal-faced composite wall/soffit panel assemblies capable of withstanding effects of following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
   1. Wind Loads: Determine loads based on following minimum design wind pressures:
      a. Uniform pressure of 30 lb/sq. ft. unless otherwise indicated on Drawings.
   2. Deflection Movement: Provide installed MCM systems that have been designed to resist to wind loading, acting inward and outward, defined for project:
      a. Perimeter Framing Deflection: Deflection of panel perimeter framing member shall not exceed L/175 normal to plane of wall/soffit where “L” is unsupported span of perimeter framing member.

b. Panel Deflection: Deflection of panel face shall not exceed L/60 at design load where “L” is unsupported span of panel.
c. Anchor Deflection: At connection points of framing members to anchors, anchor deflection in any direction shall not exceed 0.0625 inch.
d. At 150 percent pressure, no permanent deformation exceeding L/1000 or failure to structural members is permitted.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): Minus 20 to plus 180 deg. F ambient; 180 deg. F material surfaces.
2. Fabrication, assembly and erection procedures shall take into account ambient temperature range at time of respective operation.

E. System Requirements: (System Type Dependent)
1. Wet System – (Tested to AAMA 501 Standard)
a. ASTM E 283 – Air Leakage: Not more than 0.06 cfm per ft2 of wall area when tested at 6.24 psf.
b. ASTM E 331 – Static Water Penetration: When tested under static pressure at 12.0 psf minimum, for a time period of 15 minutes. MCM systems must have:
1) No uncontrolled water leakage to room side of assembly when tested as defined by process.
c. AAMA 501.1 – Dynamic Water Penetration: When tested with a wall/soffit pressure equivalent to 12.0 psf for a time period of 15 minutes, MCM system must have:
1) No uncontrolled water leakage to room side of assembly when tested as defined by assembly.
d. ASTM E330 – Structural Performance – MCM system must be engineered to meet project design loads, however MCM system must meet or exceed following criteria when tested to a minimum pressure of 30.psf:
1) Deflections do not exceed limitations defined within section on Deflection and Thermal Movement.
2. Pressure Equalized Rain Screen System (PER) (Tested to AAMA 508 Standard).
a. AAMA 508 (Modified ASTM E 1233) – Pressure Cycle Testing: When tested, MCM system must have:
1) Lag between cavity and cyclic wind pressure shall not exceed 0.08 seconds.
2) Maximum differential between cavity and cyclic wind pressure shall not exceed 50 percent that of maximum test pressure.
b. ASTM E 331 – Static Water Penetration: When tested to AAMA 508 standards under static pressure at 12.0 psf (575 Pa) minimum, for a time period of 15 minutes, MCM system must have:
1) All water that penetrates exterior rain screen cladding including condensation shall be controlled and drained to exterior.
2) Any droplets water that contacts air/water barrier shall not exceed 5 percent of air/water barrier surface.
3) Water shall not produce any continuous stream of water on air/water barrier.
c. AAMA 501.1 – Dynamic Water Infiltration: When tested to 508 standards with a wall pressure equivalent to 12.0 psf for a time period of 15 minutes MCM system must have:
1) All water that penetrates exterior rain screen cladding including condensation shall be controlled and drained to exterior.
2) Any droplets water that contacts air/water barrier shall not exceed 5 percent of air/water barrier surface.
3) Water shall not produce any continuous stream of water on air/water barrier.

d. ASTM E330 (modified AAMA 508) – Structural Performance – MCM system must be engineered to meet project design loads, however MCM system must meet or exceed following criteria when tested to a minimum pressure of 30.0 psf. Note: ASTM E330 test shall be conducted with MCM system joinery closed (taped or sealed) producing required static loads on MCM system. AWB is not to be loaded for measurement.
   1) Deflections do not exceed limitations defined within section on Deflection and Thermal Movement.

3.

F. Fire-Resistive Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

2.2 METAL-FACED COMPOSITE WALL/SOFFIT PANELS

A. Metal Composite Material Wall/soffit Panel Systems: Provide factory-formed and -assembled, metal-faced composite wall/soffit panels fabricated from two metal facings bonded to solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight or rainscreen system.
   1. Fire-Retardant Core: Noncombustible, with following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
      a. Flame-Spread Index: 15 or less.
      b. Smoke-Developed Index: 120 or less.
      c. Flammability, Exterior, Non-Load-Bearing wall assemblies and panels, NFPA 285: Pass.
   2. Products: Subject to compliance with requirements, provide one of following:
      a. Alucobond Plus; 3A Composites USA Inc.
      b. Reynobond FR; Alcoa Inc.
      c. Larson by Alucoil; Alucoil North America
      d. Alcotex; Alcotex/FR.
   3. Products of other manufacturers will be considered for acceptance provided they equal or exceed material requirements and functional qualities of specified product. Requests for A/E's approval must be accompanied by "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

B. Aluminum-Faced Composite Wall/soffit Panels: Formed with 0.020-inch thick, coil-coated aluminum sheet facings.
   1. Panel Thickness: 0.157-inch, minimum.
   2. Core: Fire retardant, unless otherwise noted.
   3. Exterior Finish: 2-coat fluoropolymer.
      a. Color: Refer to "List of Finishes"
         1) Match Pantone PMS 282 C#041E42, where indicated.
   4. Fire Performance: (Class A Material)
      a. ASTM E 84: MCM shall have a flame spread index of not more than 25 when tested in maximum thickness intended for use.
      b. ASTM E 84: MCM shall have a smoke developed index of not more than 450 when tested in maximum thickness intended for use.
      c. Surface Flammability, modified ASTM E108: Pass.
   5. Bond Integrity: Test for resistance to delamination as follows:
      a. MCM panels with a solid core of extruded thermal plastic.
         1) Peel Strength (ASTM D 1781): 22.5-inch lb./in minimum as manufactured.

2) No degradation in bond performance after 8 hours of submersion in water at 212 degrees F or 21 days of immersion in water at 70 degrees F.
3) Thermally bonded to core material in a continuous process under heat, pressure, and tension.

b. MCM panels with a high pressure injected liquid plastic core.
1) Average Flatwise Tensile Strength (ASTM C 297): 400 psi. Individual values within a test group shall be within 154 percent of group average, or lowest test value is used.

C. Attachment System Components: Formed from extruded aluminum.
1. Include manufacturer's standard perimeter extrusions panel stiffeners, panel clips, and anchor channels.

D. Attachment Assembly: Manufactures standard for system utilized.

2.3 MISCELLANEOUS METAL FRAMING

A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653, G90 hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panels systems.

B. Base or Sill Angles or Channels: 0.079-inch nominal thickness.

C. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous metal framing members to substrates.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide fabricator’s standard MCM system accessories, including fasteners, clips, anchorage devices, and attachments for specific applications indicated on contract documents.

B. Wall/soffit Panel Accessories: Provide components required for a complete metal-faced composite wall/soffit panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal-faced composite wall/soffit panels unless otherwise indicated.

C. Flashing and Trim: Formed from same material as metal composite materials panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal-faced composite wall/soffit panels.

D. Fasteners/Attachment System Components: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal-faced composite wall/soffit panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.
1. Attachment System Components: Formed from extruded aluminum to meet specified design loads and system test performance according to each MCM System Fabricator’s design. Galvanized cold formed steel clips or staggered aluminum angles are not acceptable for panel to panel attachment.

E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain watertight; and as recommended in writing by metal composite material panel manufacturer.

F. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
   1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
   2. Low Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
   3. Products:
      a. Dri-Start "HR" High Performance Roofing Underlayment; Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.
      b. Vycor Ultra; GCP Applied Technologies, Inc.
      c. Perma-Seal PE; Henry Company.
      d. MetShield; Metal-Fab Manufacturing, LLC.
      e. WIP 300HT; TC MiraDRI.

2.5 FABRICATION

A. Fabricators: Must be a Certified MCM Fabricator by Metal Construction Association (MCA) or be listed as an approved fabricator.
   1. Approved Fabricators
      a. Miller-Clapperton Partnership, Inc.
      b. East Coast Metal Systems, Inc.
      c. CEI Composite Materials, LLC
      d. Custom Metal Contracting Ltd.
      e. Tremco CPG Inc.
      f. Quality Metalcrafts, LLC/Americlad.
      g. Shaffner Heaney Associates, Inc.
      h. Sobotec LTD
      i. Riverside Group.
      j. Elward Systems Corp.
      k. Universe Corp.
      l. Compositecore, a Division of Doralco Architectural Metal Solutions
      m. SPS Corporation
      n. Royalton Architectural Fabrication
      o. Sierra Metals, Inc.
      p. Fox Enterprise Services.
      q. Kanalco LTD.
      r. Aflex Plate; Aflex, LLC
   2. Fabricators Requirements: To be listed as an approved fabricator provide following supporting documentation ten days prior to bid.
      a. MCM System Fabricator shall demonstrate and offer within attested certification by at least one specified MCM manufacturer that they have fabricated; a minimum of 150,000 square feet of architectural walls per year, that are used as building weathering envelope, utilizing MCM of at least 4mm (0.157 inch) thickness.
      b. System components shall be shop fabricated.
      c. Fabrication of other types of panels or fabricator’s goods is not considered as meeting above requirement.
   3. Product of other fabricators will be considered for acceptance provided they comply with material requirements and functional qualities of this Section. “Substitution Request Form” and complete technical data must be received by A/E at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

B. General: Fabricate and finish metal-faced composite wall/soffit panels and accessories at factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

C. Fabricate metal-faced composite wall/soffit panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

D. Metal-Faced Composite Wall/soffit Panels: Factory form panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.
   1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
   2. Fabricate panels with sharply cut edges, with no displacement of face sheets or protrusion of core material.
   3. Fabricate panels with panel stiffeners, as required to comply with deflection limits, attached to back of panels with structural silicone sealant or bond tape.
   4. Dimensional Tolerances:
      a. Length: +/-0.079 inch @ 70 degrees F.
      b. Width: +-0.079 inch @ 70 degrees F.
      c. Thickness: Plus or minus 0.008 inch.
      d. Squareness: +/-0.079 inch @ 70 degrees F.

E. System Type(s)
   1. Wet System: System must provide a wet seal (caulked) panel joints and must feature provisions to drain to exterior face of wall/soffit any leakage of water at joints and any condensation that may occur within wall/soffit cavity as tested per AAMA 501. Sealant type shall be as approved by MCM manufacturer.
   2. Pressure Equalized Rain Screen System: System must provide an open panel joint design with precise venting to allow air to quickly pass through panel joinery while preventing water infiltration from contacting air/water barrier as tested per AAMA 508. System must be properly compartmentalized to prevent internal cavity air moving between different pressure zones of building’s surfaces.

F. Attachment System Components
   1. Formed from extruded aluminum as indicted to meet the specified design loads and system test performance according to each MCM System Fabricator’s design.
   2. Panel stiffeners as required, shall be positively engaged in the perimeter extrusion or mechanically fastened to the perimeter extrusion and shall be secured to the rear face of the composite panel with silicone or high-strength double-sided bonding tape of sufficient size and strength to maintain panel’s specified deflection under load. Structural calculations shall be provided to show the adequacy of this connection to resist the applied loads. Galvanized steel and MCM are not to be used as stiffener elements. Only panel stiffeners composed of extruded aluminum, or 300 Series stainless steel shapes shall be adequate.

G. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
   1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
   2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
   3. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
   4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
   5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal-faced composite wall/soffit panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal-faced composite wall/soffit panel manufacturer for application, but not less than thickness of metal being secured.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

D. Aluminum Panels and Accessories:
1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal-faced composite wall/soffit panel supports, and other conditions affecting performance of Work.
1. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal-faced composite wall panel manufacturer.
a. Verify that underlayment or weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
2.

B. Examine roughing-in for components and systems penetrating metal-faced composite wall/soffit panels to verify actual locations of penetrations relative to seam locations of panels before panel installation.

C. For record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall/soffit panel support members and anchorage according to ASTM C 754 and metal-faced composite wall/soffit panel manufacturer's written instructions.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering High-Temperature Sheet Underlayment:
1. Install self-adhering high-temperature sheet underlayment, wrinkle free.

2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days of installation.
8. Install self-adhering high-temperature underlayment, where indicated.

3.4 METAL-FACED COMPOSITE WALL/SOFFIT PANEL INSTALLATION

A. General: Install metal-faced composite wall/soffit panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor panels and other components of Work securely in place, with provisions for thermal and structural movement.
1. Commence metal-faced composite wall/soffit panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
2. Shim or otherwise plumb substrates receiving metal-faced composite wall/soffit panels.
3. Flash and seal metal-faced composite wall/soffit panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by panels are installed.
4. Install screw fasteners in predrilled holes.
5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Install flashing and trim as metal-faced composite wall/soffit panel work proceeds.
7. Locate panel splices over, but not attached to, structural support. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
8. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
10. Provide weathertight escutcheons for pipe and conduit penetrating exterior wall/soffits.

B. Fasteners:
1. Aluminum Wall/soffit Panels: Use aluminum or stainless-steel fasteners.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal-faced composite wall/soffit panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal-faced composite wall/soffit panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.
1. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

E. Attachment System Installation, General: Install attachment system required to support metal-faced composite wall/soffit panels and to provide a complete weathertight wall/soffit system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
1. Include attachment to supports, panel-to-panel joinery, and panel-to-dissimilar-material joinery, and panel-system joint seals.
2. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.

F. Clip Installation: Attach panel clips to supports at each metal-faced composite wall/soffit panel joint at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-returned flanges of wall/soffit panels to panel clips with manufacturer's standard fasteners.
   1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Division 07 Section "Joint Sealants."

G. Rainscreen-Principle Installation: Provide manufacturer's standard pressure-equalized, rainscreen-principle system with vertical channel that provides support and complete secondary drainage system, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach wall panels by engaging horizontal support pins into notches in vertical channels and into flanges of wall panels. Leave horizontal and vertical joints with open reveal.
   1. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
   2. Do not apply sealants to joints unless otherwise indicated on Drawings.

3.5 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal-faced composite wall/soffit panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with mastic sealant (concealed within joints).

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal-faced composite wall/soffit panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 FIELD QUALITY CONTROL

A. Fabricator’s Field Services: Provide fabricator’s field service consisting of products use recommendations and periodic site visit for inspection of product installation in accordance with fabricator’s instructions.
   1. Site Visits: At minimum provide following:
      a. Pre-installation meeting.
      b. For first 10 sq.ft. installed.
      c. Final inspection of completed work.

3.8 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal-faced composite wall/soffit panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal-faced composite wall/soffit panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.

B. After metal-faced composite wall/soffit panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal-faced composite wall/soffit panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
   1. Repair components of MCM system with minor damage such that repairs are not discernible at a distance of 10 feet from surface at a 80 degree angle per AAMA 2605.

D. Verify weep holes and drainage channels are unobstructed and free of dirt and sealants.

END OF SECTION 07 42 43

DIVISION 08 OPENINGS

SECTION 08 06 71 – DOOR HARDWARE SCHEDULE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section references specification sections relating to commercial door hardware for the following:

1. Swinging doors.
2. Sliding Doors.
3. Other doors to the extent indicated.

B. Commercial door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical and access control door hardware.
3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
4. Automatic operators.
5. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Door Hardware”.
2. Division 26 Section “Electrical”.

D. Codes and References: Comply with the version adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum [5] years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum [3] years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum [5] years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Source Limitations: Obtain each type and variety of Door Hardware specified in the Related Sections from a single source, qualified supplier unless otherwise indicated.

E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the applicable model building code.

F. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.

1. Section 08 71 00 – Door Hardware.

C. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. RO - Rockwood
4. SC - Schlage
5. VO - Von Duprin
6. HS - HES
7. NO - Norton Rixson
8. LC - LCN Closers
9. SU - Securitron

Hardware Sets

Set: 1.0

Doors: 107B

2	Continuous Hinge	CFM-SLF-HD1-M x Length Required		PE	087100
1	CVR Exit, Nightlatch	98 Series; Rhodes Lever	.630	VO	087100
1	CVR Exit, Exit Only	98 Series; Rhodes Lever	.630	VO	087100
2	Concealed Overhead Stop	6-X36	630	NO	087100
2	Surface Closer	4040XP Series (Arm to Suit)	.689	LC	087100
2	Sweep	3452CNB x Length Required		PE	087100
1	Threshold	27_x224AFGT x Length Required		PE	087100

Notes: Perimeter and meeting stile gasket by door/frame manufacturer.

Set: 2.0

Doors: 140B

1	Continuous Hinge	CFM-SLF-HD1-M x Length Required		PE	087100
1	Rim Exit, Classroom	98 Series; Rhodes Lever	.630	VO	087100
1	Cylinder	20-740	.626	SC	087100
1	Concealed Overhead Stop	6-X36	630	NO	087100
1	Surface Closer	4040XP Series (Arm to Suit)	.689	LC	087100
1	Sweep	3452CNB x Length Required		PE	087100
1	Threshold	27_x224AFGT x Length Required		PE	087100

Notes: Perimeter gasket by door/frame manufacturer.

Set: 3.0

Doors: 137B

1	Continuous Hinge	CFM-SLF-HD1-M x Length Required		PE	087100	
1	Rim Exit, Classroom	98 Series; Rhodes Lever	.630	VO	087100	
1	Electric Strike	7000C	630	HS	087100	⚡
1	SMART Pac Bridge Rectifier	2005M3		HS	087100	⚡
1	Concealed Overhead Stop	6-X36	630	NO	087100	
1	Door Operator	4640 Series	.689	LC	087100	⚡
1	Sweep	3452CNB x Length Required		PE	087100	
1	Threshold	27_x224AFGT x Length Required		PE	087100	
1	ElectroLynx Harness - Frame	QC-C1500P		MK	087100	⚡
2	Actuator	As Required		LC	087100	
1	Power Supply	AQL4-R8E1 x Relays as Required		SU	087100	⚡

Notes:
Operational description: Door normally closed, secured by key. When unlocked, access by lever. When scheduled, hands free entry by actuator activates door operator. Free egress always. Door remains latched in event of power loss or fire alarm.

Set: 4.0

Doors: 250

4	Continuous Hinge	CFM-HD1 x Length Required		PE	087100	
1	Storeroom Lock	ND Series; Rhodes Lever	.626	SC	087100	
1	Cylinder	20-740	.626	SC	087100	
1	Surface Closer	4040XP Series (Arm to Suit)	.689	LC	087100	
1	Wall Stop	RM860 (or) RM861 (As Required)	US26D	RO	087100	
2	Gasketing	290APK (Jambs)		PE	087100	
1	Gasketing	2891APK (Heads)		PE	087100	
1	Rain Guard	346C (Omit at overhangs)		PE	087100	
1	Sweep	3452CNB x Length Required		PE	087100	
1	Threshold	27_x224AFGT x Length Required		PE	087100	

Set: 5.0

Doors: 117

4	Hinge, Full Mortise	TA2714-MCK [NRP]	US26D	MK	087100	
1	Storeroom Lock	ND Series; Rhodes Lever	.626	SC	087100	
1	Cylinder	20-740	.626	SC	087100	
1	Electric Strike	5000C	630	HS	087100	⚡
1	SMART Pac Bridge Rectifier	2005M3		HS	087100	⚡
1	Surface Closer	4040XP Series (Arm to Suit)	.689	LC	087100	
1	Wall Stop	RM860 (or) RM861 (As Required)	US26D	RO	087100	
1	ElectroLynx Harness - Frame	QC-C1500P		MK	087100	⚡
1	Card Reader	By Security Supplier				
1	Power Supply	AQL4-R8E1 x Relays as Required		SU	087100	⚡

Notes: Perimeter gasket by door/frame manufacturer.
Operational narrative: Door normally closed and secure. Access by valid credential. Free egress always. Door remains latched and secure upon power loss or fire alarm activation. Keyed cylinder for emergency access.

Set: 6.0

Doors: 137A

3	Hinge, Full Mortise, Hvy Wt	T4A3786-MCK [NRP]	US26D	MK	087100	
1	Rim Exit, Nightlatch	98 Series; Rhodes Lever	.630	VO	087100	
1	Cylinder	20-740	.626	SC	087100	
1	Electric Strike	7000C	630	HS	087100	⚡
1	SMART Pac Bridge Rectifier	2005M3		HS	087100	⚡
1	Surface Closer, Stop Arm	4040XP Series	.689	LC	087100	
1	ElectroLynx Harness - Frame	QC-C1500P		MK	087100	⚡
1	Card Reader	By Security Supplier				
1	Power Supply	AQL4-R8E1 x Relays as Required		SU	087100	⚡

Notes: Perimeter gasket by door/frame manufacturer.
Operational narrative: Door normally closed and secure. Access by valid credential. Free egress always. Door remains latched and secure upon power loss or fire alarm activation. Keyed cylinder for emergency access.

Set: 7.0

Doors: 119

3	Hinge, Full Mortise	TA2714-MCK [NRP]	US26D	MK	087100	
1	Storeroom Lock	ND Series; Rhodes Lever	.626	SC	087100	
1	Cylinder	20-740	.626	SC	087100	
1	Electric Strike	5000C	630	HS	087100	⚡
1	SMART Pac Bridge Rectifier	2005M3		HS	087100	⚡
1	Concealed Overhead Stop	6-X36	630	NO	087100	
1	Surface Closer	4040XP Series (Arm to Suit)	.689	LC	087100	
1	Wall Stop	RM860 (or) RM861 (As Required)	US26D	RO	087100	
3	Silencer	608-RKW		RO	087100	
1	ElectroLynx Harness - Frame	QC-C1500P		MK	087100	⚡
1	Card Reader	By Security Supplier				
1	Power Supply	AQL4-R8E1 x Relays as Required		SU	087100	⚡

Notes: Perimeter gasket by door/frame manufacturer.
Operational narrative: Door normally closed and secure. Access by valid credential. Free egress always. Door remains latched and secure upon power loss or fire alarm activation. Keyed cylinder for emergency access.

Set: 8.0

Doors: 120

3	Hinge, Full Mortise	TA2714-MCK [NRP]	US26D	MK	087100
1	Classroom Lock	ND Series; Rhodes Lever	.626	SC	087100
1	Cylinder	20-740	.626	SC	087100
1	Concealed Overhead Stop	6-X36	630	NO	087100
1	Surface Closer	4040XP Series (Arm to Suit)	.689	LC	087100

Notes: Perimeter gasket by door/frame manufacturer.

Set: 9.0

Doors: 107A

2	Continuous Hinge	CFM-SLF-HD1-M x Length Required		PE	087100	
2	Dummy Push Pad	350	.630	VO	087100	
2	Exit Device Trim	Rhodes Lever	.630	VO		
2	Concealed Overhead Stop	6-X36	630	NO	087100	
2	Surface Closer	4040XP Series (Arm to Suit)	.689	LC	087100	
2	Sweep	18061CNB x Length Required		PE	087100	
1	Threshold	271A x Length Required		PE	087100	

Notes: Perimeter and meeting stile gasket by door/frame manufacturer.

Set: 10.0

Doors: 138

3	Hinge, Full Mortise	TA2714-MCK [NRP]	US26D	MK	087100	
1	Storeroom Lock	ND Series; Rhodes Lever	.626	SC	087100	
1	Wall Stop	RM860 (or) RM861 (As Required)	US26D	RO	087100	
1	Gasketing	S88BL (Head & Jambs)		PE	087100	
1	ElectroLynx Harness - Frame	QC-C1500P		MK	087100	⚡
1	Restroom Kit	8310-2420		LC	087100	
1	Power Supply	AQL4-R8E1 x Relays as Required		SU	087100	⚡
1	Coat Hook	RM801	US26D	RO	087100	

Notes:
Operational description: Door normally closed and secure. Access by actuator, activating the door operator. Interior "Push to Lock" button disables access when in use. Free egress always. Hands free egress by actuator activates door operator. Door remains latched in event of power loss or fire alarm.

Set: 11.0

Doors: 122

3	Hinge, Full Mortise	TA2714-MCK [NRP]	US26D	MK	087100
1	Storeroom Lock	ND Series; Rhodes Lever	.626	SC	087100
1	Cylinder	20-740	.626	SC	087100
1	Surface Closer	4040XP Series (Arm to Suit)	.689	LC	087100
1	Wall Stop	RM860 (or) RM861 (As Required)	US26D	RO	087100
3	Silencer	608-RKW		RO	087100

Set: 12.0

Doors: 141

3	Hinge, Full Mortise	TA2714-MCK [NRP]	US26D	MK	087100
1	Storeroom Lock	ND Series; Rhodes Lever	.626	SC	087100
1	Cylinder	20-740	.626	SC	087100
1	Surface Closer, Stop Arm	4040XP Series	.689	LC	087100
3	Silencer	608-RKW		RO	087100

Set: 13.0

Doors: 112, 114, 116, 118, 134, 135, 136

3	Hinge, Full Mortise	TA2714-MCK [NRP]	US26D	MK	087100
1	Entrance/Office Lock	ND Series; Rhodes Lever	.626	SC	087100
1	Cylinder	20-740	.626	SC	087100
1	Wall Stop	RM860 (or) RM861 (As Required)	US26D	RO	087100
3	Silencer	608-RKW		RO	087100

Set: 14.0

Doors: 139

3	Hinge, Full Mortise	TA2714-MCK [NRP]	US26D	MK	087100
1	Privacy Lock (w/ Indicator)	ND Series; Rhodes Lever	.626	SC	087100
1	Surface Closer, Hold Open	4040XP Series	.689	LC	087100
1	Wall Stop	RM860 (or) RM861 (As Required)	US26D	RO	087100
1	Gasketing	S88BL (Head & Jambs)		PE	087100
1	Coat Hook	RM801	US26D	RO	087100

Set: 15.0

Doors: 125

6	Hinge, Full Mortise, Hvy Wt	T4A3786-MCK [NRP]	US26D	MK	087100
1	Dust Proof Strike	570	US26D	RO	087100
1	Flush Bolt	2945	US26D	RO	087100
1	Double Dummy Trim	ND Series; Rhodes Lever	.626	SC	087100
1	Deadbolt, Double Cylinder	B660 Series	.626	SC	087100
2	Cylinder	20-740	.626	SC	087100
2	Surface Closer, Hold Open	4040XP Series	.689	LC	087100
2	Wall Stop	RM860 (or) RM861 (As Required)	US26D	RO	087100
2	Silencer	608-RKW		RO	087100

Set: 16.0

Doors: 130

3 Hinge, Full Mortise, Hvy Wt	T4A3786-MCK [NRP]	US26D	MK	087100
1 Double Dummy Trim	ND Series; Rhodes Lever	.626	SC	087100
1 Surface Closer, Hold Open	4040XP Series	.689	LC	087100
1 Wall Stop	RM860 (or) RM861 (As Required)	US26D	RO	087100
3 Silencer	608-RKW		RO	087100

Set: 17.0

Doors: 131

1 Cylinder	20-740	.626	SC	087100

END OF SECTION 08 06 71

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "Sustainable Design Requirements".
2. Division 01 Section "General Conditions".
3. Division 04 Section "Masonry".
4. Division 06 Section "Rough Carpentry".
5. Division 06 Section "Finish Carpentry".
6. Division 08 Section "Operations and Maintenance".
7. Division 08 Section "Door Hardware Schedule".
8. Division 08 Section "Flush Wood Doors".
9. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
10. Division 08 Section "Glazing".
11. Division 08 Section "Door Hardware".
12. Division 09 Sections "Painting".
13. Division 26 Section "Electrical"

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

9. SDI-113 Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door & Frame Assemblies.
10. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
11. ASTM C1199 - Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods
12. ASTM E1423 - Practice for Determining Steady State Thermal Transmittance of Fenestration Systems.
13. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
14. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
15. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
16. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
17. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
18. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
19. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.

a. Smoke "S" Label: Doors to bear “S” label and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).
3. Pioneer Industries (PI).
4. Steelcraft (S).

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.

a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

2. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
3. Vertical Edges: Vertical edges to have the face sheets spot welded and filled full height with an epoxy filler. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

2.4 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with SDI-113, ASTM C1363, ASTM C1119, ASTM E1423, NFRC 102 and resistance to air infiltration in accordance with ASTM-E283. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16” positive thermal break and integral vinyl weatherstripping.

C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
3. Manufacturers Basis of Design:

    a. CECO Door Products (C) - BU DU Series.
    b. CECO Door Products (C) - SU Series.

D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.7 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Knocked Down Frames: Provide frames with locking corner tabs which permit field assembly. Factory install compression type anchors and countersunk screw holes to secure the bottom of the jambs.
4. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
5. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
6. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
7. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
8. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
9. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
10. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches on-center and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
11. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.9 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION 08 11 13

SECTION 08 12 13 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hollow metal frames

B. Coordination: Refer to Division 08 Section “Glazing” to obtain glass thickness requirements. Provide properly sized stops and bead to house the specified glass according to the glass manufacturer's recommendations and as indicated.

C. Related Sections:
   1. Division 07 Section “Joint Sealants”: For caulking between metal frames and adjacent materials.
   2. Division 08 Section “Flush Wood Doors”.
   3. Division 08 Section “Door Hardware” for coordination and for testing and inspection.
   4. Division 08 Section “Glazing”.
   5. Division 09 Section “Interior Painting”.
   6. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.
      a. Exception: Low-voltage wiring for security/access control and for automatic door operator switches is pulled by the Division 28 ("Electronic Safety and Security") security/access control contractor.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI A250.8.

1.3 COORDINATION

A. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems, including electrified hardware backbox assemblies and conduit factory installed in door frames.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of frame specified, including details of construction, materials, dimensions, hardware preparation, label compliance, and finishes.

B. Shop Drawings:
   1. Provide schedule of frames using same reference numbers for details and openings as those on Contract Drawings and Schedules.
   2. Elevations of each door frame type.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of electrified hardware backbox and conduit factory installed in door frames and preparation for electrified hardware, access control systems, and security systems.
   7. Details of anchorages, joints, field splices, and connections.
   8. Details of accessories.
   9. Details of moldings, removable stops, and glazing.

C. Product Schedule: For hollow-metal frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on drawings. Coordinate with door hardware schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver frames cardboard wrapped or crated to provide protection during transit and job storage.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store frames at building site under cover. Place units on minimum 4-inch-high wood blocking. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

D. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
1. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

B. Door Size Field-Verification: Contractor/Frame Supplier shall note that the door sizes as listed on the door schedule, for new frames in existing openings, are approximate and are for bidding purposes only. The Contractor/Frame Supplier MUST field verify door size, frame preps, and other frame conditions prior to submission of Shop Drawings and fabrication of frames. It will be assumed, by the A/E, that the door size as indicated on the Shop Drawings has been field-verified by the Contractor/Frame Supplier. Frames shipped to the Project site that are incorrect size for the existing opening shall be the responsibility of the Contractor/Frame Supplier to replace at no additional cost to the Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
a. Ceco Door Products; Div. of Assa-Abloy Group Company
b. Steelcraft; Div. of Ingersoll-Rand
c. Curries; Div. of Assa-Abloy Group Company
d. Mesker Door Inc.
e. The MPI Group, LLC
f. Deansteel Manufacturing Company
g. Security Metal Products.
h. Door Components, Inc.
i. Pioneer Industries
j. Republic Doors and Frames.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the “Substitution Request Form” and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Openings shall be provided to conform with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local Regulations. Where openings, in the opinion of the supplier/manufacturer, do not conform, the A/E shall be notified.

B. Electrified Hardware Backbox Assemblies: Manufactured assemblies complying with UL 10C that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for concealed installation within hollow metal frames.

C. Conduit, Connectors, and Fittings: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.

2.3 MATERIALS

A. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A1008, Drawing Steel, Type B; stretcher-leveled standard of flatness.

B. Shop Applied Paint: For steel surfaces, use rust-inhibitive enamel or paint, either air drying or baking, suitable as a base for specified finish paints.
1. Comply with ANSI A250.10 for acceptance criteria.

C. Glazing: Comply with requirements in Division 08 Section “Glazing.”

D. Mineral Fiber Insulation: ASTM C 665, Type 1 (blankets without membrane facing); consisting of fibers manufactured from slag or rock wood with a 6 to 16 pounds per cubic foot density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

2.4 FRAME TYPES

A. General: Provide steel frames for doors, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

B. Frames for interior door openings and borrowed lights shall be fabricated with 2 inch face at jambs, heads and mullions, unless otherwise indicated.
1. 0.053-inch thick (fka 16 gauge) steel, cold rolled, factory applied baked on primer, for Level 2 and Level 3 steel doors and wood doors.
2. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
3. Construction: Full profile welded, unless otherwise noted.
4. Exposed Finish: Prime.

C. Full Profile Welded Frames: Frames for steel stud and drywall construction shall be mitered or butted and set-up and welded, "SUW", with welds on exposed surfaces, dressed smooth and flush. Provide a temporary spreader bar securely fastened to the bottom of each frame. Butt welded frames without back bend at head and jamb joint will not be acceptable.

2.5 FRAME ASSEMBLIES

A. Stops and Beads: Furnish minimum 0.032-inch thick (fka 20 gauge) sheet steel glazing beads with the hollow metal frames at transoms, side lights, interior glazed panels, and other locations where beads are indicated in pressed steel frames. Glazing beads for exterior frames shall be on the interior side of transoms and sidelights. Glazing beads for interior frames shall be located on the secure side of opening.

B. Mortar/Plaster Guards: Provide minimum 0.016-inch thick (fka 26 gauge) steel plaster guards or mortar boxes, welded to the frame, at back of door hardware cutouts where mortar or other materials might obstruct hardware operation.

C. Provide minimum 0.1495 inch thick (fka 9 MSG) hinge reinforcement, including all doors with continuous-type hinges.

D. Provide minimum 0.1046 inch thick (fka 12 MSG) frame head reinforcement for closers, surface, and concealed overhead stop and holders, removable mullions, flush bolts, and top latch of vertical rod exit devices.

E. Door Silencers: Drill stops and install 3 silencers on strike jambs of single swing frames and 2 silencers on heads of double swing frames.

2.6 FRAME ANCHORAGE

A. Wall, Floor, and Head Anchors
   1. Frames Set in Metal Stud Partitions: Provide a minimum of three 0.042 inch thick (fka 18 gauge) metallic coated "Z" shaped sheet metal jamb anchor clips welded in each jamb. For doors over 7’-6” high weld one additional anchor for each 24 inches or fraction thereof.
   2. Provide head anchors at door or window heads over 5 feet wide at minimum 3 feet o.c.
   3. Provide 0.067 inch thick (fka 14 gauge) minimum angle shaped floor clips welded to jambs and punched for two 3/8 inch diameter bolts each.
   4. Provide adjustable length clip angles as required.

2.7 DOOR FRAME ACCESSORIES

A. Electrified Hardware Backbox Assemblies (Contractor’s Option): Manufactured back-box and conduit connector assembly, factory-installed to inside of door frame, specifically designed for connection of conduit as an internally smooth pathway for fishing and installing wiring and terminating connections for electrified door hardware and access control devices installed within or connected to door frame. Assemblies must accommodate wire routing without disconnection of assembly components, without field modifications to frame, and without frame removal after installation.
   1. Subject to compliance with requirements, provide the following:
      a. Electrified Hardware Backbox Assembly: Injection-molded, ABS (Acrylonitrile butadiene styrene) plastic enclosure manufactured with integral ports, at each end of enclosure, for solvent connection of PVC conduit within the frame. Include integral ports for connection and extensions of conduit specified in Division 26 and 28 that will extend from the frame to other locations such as above ceiling or other remote devices such as card readers, tec. Include QR Code Labels for identification that each frame has been provided with control wiring pathways.
         1) Product: FRAMEFROG, as manufactured by Tadpole Products, LLC. 223 Fairfield Ave., Bellevue, Kentucky 41073. Tadpoleproducts.org phone 513-702-5436. Provide 1/2-inch diameter rigid PVC conduit between each ABS back-box assembly located within the door frame as indicated drawings.

B. Door Frame Conduits (Contractor's Option)
   1. Manufactured conduits, factory installed to the inside of door frame, that connect to each back box within the full perimeter of the door frame. Provide conduits located within the frame per the drawings and manufacturer's installation instructions. Conduits exiting the frame shall be per Divisions 26 and 28 of these specifications.
      a. Conduit: Provide 1/2-inch Schedule 40 rigid PVC conduit compatible with the back box materials used.
      b. Manufacturer
         1) Cantex
         2) Carlon by Thomas Betts

C. Metal Mortar-Dust Boxes (Contractor's Option)
   1. Provide at all hardware locations where electrified hardware backbox assemblies are NOT installed.
      a. Provide a metal cover attached to the frame behind reinforcement for any mortised or recessed non-electrified hardware locations, to prevent mortar or plaster from entering the mounting holes.

2.8 FABRICATION

A. Fabricate steel door frame units to comply with ANSI A250.8 and be rigid, neat in appearance, and free from defects, warp, or buckle. Accurately form metal to required sizes and profiles. Wherever practicable, fit and assemble units in the manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at the Project site.

B. Fabricate concealed stiffeners, reinforcement, edge channels, and moldings from either cold rolled or hot rolled steel (at fabricator's option).

C. Clearances for Doors: Not to exceed 1/8 inch at jambs and heads, 3/32 inch between pairs of doors, and 3/4 inch at bottom.

D. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

E. Exposed fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

F. Sound Rated (Acoustical) Assemblies: At offices, provide frame assemblies fabricated as sound reducing type, classified according to ASTM E413.
   1. Unless otherwise indicated, provide acoustical assemblies with STC sound ratings of 33 or better.

G. Door Hardware Preparation: Factory prepare hollow-metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
   1. Prepare hollow metal units to receive mortised and concealed door hardware, including cutouts, steel reinforcing, drilling, and tapping in accordance with final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A250.6 and ANSI/BHMA A156.115 for preparation of hollow-metal work for hardware.
   2. Reinforce hollow metal units to receive non-templated, mortised, and surface mounted hardware. Hardware installer shall drill and tap for surface applied hardware.

H. Stops and Moldings: Manufacturer's standard, formed from minimum 0.032 inch thick (fka 20 gauge) steel sheet stops and moldings around glazed lites and louvers. Form corners of stops and moldings with butted or mitered hairline joints.
   1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.

2. Provide fixed frame moldings on outside of exterior and on secure side of interior frames. Provide loose stops and moldings on inside of hollow-metal frames.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
4. Provide stops for installation with countersunk flat- or oval-headed machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

I. Accessories
1. Install electrified hardware backbox assemblies per manufacturer's installation instructions, at each location where electrified door hardware is scheduled, or where specified for future electrified door hardware.
2. Connect each back-box located within the frame by means of a 1/2 inch diameter PVC conduit.
3. Metal Mortar-Dust Cover: Weld metal covers to frames at back of hardware mortises in frames to be grouted, except where electrified hardware back-box assemblies are scheduled.

2.9 STEEL FINISHES

A. General: Comply with recommendations in "Metal Finishes Manual" by Architectural and Metal Products Division of National Association of Architectural Metal Manufacturers (NAAMM) for applying and designating finishes.
1. Finish standard steel frames after assembly.

B. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning".

C. Factory Priming for Field Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.
1. Shop Primer: Manufacturer's standard, fast curing, lead and chromate free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field applied finish paint system indicated; and providing a sound foundation for field applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of standard steel frames.
1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory prior to setting frames. Restore exposed finish by grinding, fitting, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Prior to installation and with Contractor-installed installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
   1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. Alignment: Plus or minus 1/16 inch, measured on jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap frames to receive non-templated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install steel frames and accessories according to shop drawings, manufacturer's data, and as specified.

B. Standard Steel Frames: Install standard steel frames for doors, sidelights, transoms, borrowed lights, and other openings, of size and profile indicated. Comply with ANSI A250.11 or NAAMM HMMA 840 as required by standards specified.
   1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. Where frames are fabricated in sections due to shipping or handling limitations, field-splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      b. Install frames with removable glazing stops located on secure side of opening.
      c. Install door silencers in frames before grouting.
      d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      e. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   2. Floor Anchors: Provide floor anchors for each jamb and mullions that extends to floor and secure with post-installed expansion anchors.
      a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on shop drawings.
   3. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
      a. Squareness: Plus, or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
      b. Alignment: Plus, or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
      c. Twist: Plus, or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
      d. Plumbness: Plus, or minus 1/16 inch, measured at jambs at floor.

C. Door Frame Assemblies
   1. Install electrified hardware backbox assemblies per manufacturer's installation instructions.
   2. Connect each backbox located within the frame by a means of a 1/2 inch diameter PVC conduit.
   3. See Division 26 and 28 for requirements of conduits that extend outside of the frame.
   4. For frames that curtain electrified hardware backbox assemblies and conduit within the frame, apply QB Code decal provided by manufacturer on hinge side of door frame at face of door rabbet, for identified that frame has been provided with control wiring pathways.

D. Glazing: Comply with installation requirements in Division 08 Section “Glazing” and with standard steel frame manufacturer’s written instructions.
   1. Secure stops with countersunk flat or oval head machine screws spaced uniformly not more than 9 inches on center, and not more than 2 inches on center from each corner.

3.4 FIELD QUALITY CONTROL

A. Frames
   1. Install plumb, level and true to line, secured in openings.
   2. Install frames in accordance with accepted shop drawings, manufacturer's printed instructions.

B. Final Adjustment: Doors and hardware shall receive final adjustment as follows:
   1. Door Contact with Silencers: Single doors shall strike a minimum of two silencers without binding lock or latch bolts in the strike plate.
   2. Head, Strike and Hinge Jamb Margin: 1/8 inch plus-or-minus 1/16 inch.
   3. Meeting Edge Clearance, Pairs of Doors: 1/8 inch plus-or-minus 1/16 inch.
   4. Bolts and Screws: Leave tight and firmly seated.

C. Warped, bowed, or damaged work will be rejected and shall be replaced with new work.

D. Check and readjust operating hardware items immediately before final inspection.

E. Leave work in a complete and proper operating condition.

3.5 CLEANING

A. Prime Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air drying primer.

3.6 PROTECTION

A. After installation, protect frames from damage during subsequent construction activities.

END OF SECTION 08 12 13

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Factory-preparation of wood doors for hardware specified in Division 08 Section “Door Hardware”.
3. Doors shall be factory-finished.
4. Factory-fitting flush wood doors to frames, unless otherwise noted.

B. Related Sections:
1. Division 02 Section “Selective Demolition” for salvaging of existing wood doors.
2. Division 08 Section “Hollow Metal Frames”.
3. Division 08 Section “Door Hardware” for coordination for testing and inspection.
4. Division 09 Section “Interior Painting” for painting of metal frames for light openings.

1.2 ACTION SUBMITTALS

A. Product Data: Submit door manufacturer's product data, specifications, and installation instructions for each type of wood door, including door construction description and WDMA I.S.1-A and AWS classifications.
1. Include details of core and stile construction, trim for openings and louvers (if any), and similar components.
2. Include factory-finishing specifications.

B. Shop Drawings: Indicate locations, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension, and locations of hardware.
3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
4. Dimensions and locations of blocking for hardware attachment.
5. Dimensions and locations of mortises and holes for hardware.
6. Undercuts and clearances.
7. Requirements for veneer matching.
8. Doors to be factory finished and finish requirements.

C. Samples for Verification: Factory finishes applied to actual door materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of 3 samples showing typical range of color and grain to be expected in the finished work.
1. Field verify doors match existing.

1.3 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
1. Cleaning Instructions: Submit manufacturer’s cleaning instructions for doors.
2. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Comply with the applicable requirements of the following standards unless otherwise indicated:
1. ANSI/WDMA I.S. 1, "Industry Standard for Wood Flush Doors," published by Window and Door Manufacturers Association (WDMA), formerly the National Wood Window and Door Association (NWWDA).

B. Openings shall be provided to conform to the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local Regulations. Where, in the opinion of the supplier/manufacturer, openings do not conform, notify the A/E.

C. Composite wood products shall be labeled or show compliance with the Toxic Substances Control Act (TSCA) Title VI.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect wood doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced ANSI standard and recommendations of WDMA pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors," as well as with manufacturer's instructions.

B. Identify each door with individual opening numbers that correlate with designation system used on shop drawings for door, frames, and hardware, and STC or fire rating where applicable, using temporary, removable, or concealed markings.

C. Polybag protect each door for shipment and handling.

D. Waste Management and Disposal: As specified in Division 01 “Construction Waste Management and Disposal” and as follows:
   1. Separate corrugated cardboard and other protective materials in accordance with Waste Management Plan and place in designated areas for recycling.
   2. Fold up metal banding, flatten, and place in designated area for recycling.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during the remainder of the construction period to comply with requirements of the referenced quality standard for Project's geographical location.

1.7 WARRANTY

A. Special Warranty: Manufacturer’s standard form, signed by manufacturer, installer, and contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42 by 84 inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3 inch span.
   1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
   2. Warranty shall be in effect during the following period of time from date of Substantial Completion.
      a. Interior Solid-Core Interior Doors: Full Life of Original Installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Products: Subject to compliance with requirements, provide one of the products specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
      a. Masonite Architectural
      b. Lambton Doors
      c. Oregon Door

d. Oshkosh Door Company
e. VT Industries, Inc.
f. Five Lakes Manufacturing
g. Wilsonart LLC

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain doors from a single manufacturer to ensure uniformity in quality of appearance and construction.

2.2 DOOR CONSTRUCTION, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors".
1. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

B. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's' "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers".

C. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Boards "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

D. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

E. Particleboard-Core Doors:
1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde resin.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors, General:
1. ANSI/WDMA I.S. 1A Grade: Custom (Grade A faces).
2. Species: Select white birch, unless otherwise required to match existing as field verified.
3. Faces: Single-ply wood veneer not less than 1/50 inch thick.
4. Cut: Plain sliced (flat sliced), unless otherwise required to match existing as field verified.
5. Match between Veneer Leaves: Slip match.
6. Assembly of Veneer Leaves on Door Faces: Running match.
7. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
8. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet or more.
9. Exposed Vertical Edges: Solid wood of same species as faces or a compatible species-edge Type A.
10. Core:
a. Doors: Provide particle board core (PC), unless otherwise noted.
11. Construction: Five plies. Stiles and rails are bonded to core, then abrasive-plane entire unit before veneering. Faces are bonded to core using a hot press.
a. Seven plies will not be acceptable.
12. Adhesives: Type 1 in accordance with WDMA T.M.6.

2.4 PREFITTING AND PREPARATION FOR HARDWARE

A. Prefit and pre-machine wood doors at factory, including beveling both edges 1/8 inch in 2 inches. Where pairs of doors are scheduled, prefit and pre-machine as pairs. Where pairs of doors are scheduled with 3-point latching (lockset and flush bolts), the strike edge of the inactive leaf shall be square equal to WDMA meeting edge option E1.

B. Doors shall comply with tolerance requirements of NFPA 80 for pre-fitting. Machine doors for hardware requiring cutting of doors. Comply with final hardware schedules and door frame shop drawings and with hardware templates and other essential information required to ensure proper fit of doors and hardware.
   1. Top and hinge edges: 1/8 inch maximum.
   2. Single door, lock edge: 1/8 inch maximum.
   3. Pair meeting edge: 1/16 inch per leaf maximum.
   4. Bottom (rated or nonrated):
      a. 1/2 inch from decorative floor covering.
      b. 3/4 inch maximum from top of noncombustible floor.
      c. 3/8 inch maximum from top of noncombustible sill or threshold.
      d. Doors with vertical rod exit devices, manual or automatic flush bolts shall be undercut for latching of bolts to a flush floor strike or threshold.
      e. See Division 09 Section “Room Finish Schedule”, for floor finish materials.

C. Coordinate with the metal frame supplier the locations of hardware mortises in metal frames to verify dimensions and alignment before proceeding with machining in factory.

D. Factory-machine doors for hardware that is not surface-applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame, shop drawings, DHI A115-W series standards, and hardware templates.

2.5 FABRICATION

A. General:
   1. The utility or structural strength of the doors must not be impaired in fitting to the opening in applying hardware, in preparing for lights, louvers, plant-ons or other detailing.
   2. Pilot holes must be drilled for all screws that act as hardware attachments. Threaded-to-the-head screws are preferable for fastening hardware to nonrated doors and are required on fire-rated doors.
   3. In fitting for height, do not trim top or bottom edge by more than 3/4 inch, unless accommodated by additional blocking. Do not trim top edge of fire doors.

B. Factory-fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
   1. Comply with clearance requirements of referenced quality standard for fitting, unless otherwise indicated.

C. Factory-machine doors for hardware that is not surface-applied.
   1. Locate hardware to comply with DHI-WDHS-3.
   2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W and hardware template standards, and hardware templates.
   3. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory-machining.
   4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory-finishing.
   1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface-applied, before finishing.

2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Finish doors at factory.

C. Transparent Finish:
1. Grade: Custom.
2. Finish: WDMA TR-6 catalyzed polyurethane or TR-8 UV cured acrylated.
3. Staining: If required to match existing, field verify.
4. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.
1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Ensure frames are solidly anchored, allowing no deflection when doors are installed.

3.2 INSTALLATION

A. Hardware: For installation, see Division 08 Section “Door Hardware”.

B. Manufacturer’s Written Instructions: Install doors to comply with manufacturer’s written instructions, referenced quality standard, and as indicated.

C. Job-Fitted Existing Doors at Existing Frames: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer. Machine doors for hardware. Seal cut surfaces after fitting and machining.
1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 3/8 inch from bottom of door to top of threshold.
2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

D. Factory-Fitted Doors at New Openings: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

A. Inspections: Refer to Division 08 Section “Door Hardware” for egress door assembly inspections and testing.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Re-inspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

3.5 CLEANING

A. Clean doors promptly after installation in accordance with manufacturer's instructions.

B. Do not use harsh cleaning materials or methods that could damage finish.

3.6 PROTECTION

A. Protect installed doors from damage during construction.

END OF SECTION 08 14 16

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Access doors and frames for walls and ceilings.

B. Related Sections include the following:
1. Division 09 Section "Gypsum Board Assemblies" for anchoring access door frames set in gypsum board construction.
2. Division 09 Section “Interior Painting” for field painting of access doors and frames.

1.2 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer’s technical data for each type of access door and panel assembly, including setting drawings, templates, finish requirements, and details of anchorage devices.
1. Include complete schedule, type, locations, construction details, finishes, latching or locking provisions, and other pertinent data.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Manufacturer’s Installation Instructions: Indicate installation requirements and rough-in dimensions.

B. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.5 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
1. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of access door(s) and frame(s) through one source from a single manufacturer.

B. Size Variations: Obtain A/E's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Waste Management and Disposal: As specified in Division 01 “Construction Waste Management and Disposal” and as follows:
1. Separate corrugated cardboard and other protective materials in accordance with Waste Management Plan and place in designated areas for recycling.
2. Fold up metal banding, flatten, and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acudor Products, Inc.
2. Babcock-Davis.
3. Cendrex Inc.
4. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
5. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
6. Karp Associates, Inc.
7. Lane-Aire Manufacturing Corp.
8. Larsen's Manufacturing Company.
9. Maxam Metal Products Limited.
10. Metropolitan Door Industries Corp.
11. MIFAB, Inc.
12. Milcor Inc.
13. Nystrom, Inc.
14. Williams Bros. Corporation of America (The).

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Flush Access Doors with Concealed Flanges:
1. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
2. Locations: Wall.
3. Door Size: 24 inches by 24 inches, unless otherwise noted.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, (fka 16 gauge).
a. Finish: Factory prime.
5. Frame Material: Same material and thickness as door.
6. Hinges: Manufacturer's standard.
7. Hardware: See "Fabrication".

2.3 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879, with cold-rolled steel sheet substrate complying with ASTM A 1008, Commercial Steel (CS), exposed.

C. Frame Anchors: Same type as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153 or ASTM F 2329.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
   1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
   2. Provide mounting holes in frames for attachment of units to metal framing.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
   1. Provide one cylinder lock per door accessible to public, unless otherwise noted. For cylinder locks, furnish two keys per lock and key all locks alike.
      a. A latching device may be provided where doors are not accessible to public and where indicated.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Steel Finishes:
   1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify that rough openings for door and frame are correctly sized and located.
   2. Verify mechanical and electrical requirements for ceiling or wall access panels.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Advise installers of other work about specific requirements relating to access door installation, including size of openings to receive access door and frame, as well as locations of supports, insert, and anchoring devices. Furnish inserts and anchoring devices for access doors that mut be built into other construction. Coordinate delivery with other work to avoid delay.
   1. Coordinate locking requirements with Owner.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.
   1. Install frames plumb and level in opening. Secure rigidly in place.
   2. Position units to provide convenient access to concealed work requiring access.

3.4 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 08 36 13 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sectional doors assemblies.

B. Related Sections:
1. Division 08 Section “Door Hardware” for lock cylinders and keying.
2. Division 11 Section “Common Motor Requirements for Equipment” for NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements.
3. Division 26 Sections for electrical service and connections for powered operators and accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory. Include the following:
1. Construction details, material descriptions, dimensions of individual components, profile door sections, and finishes, including:
a. Preparation instructions and recommendations.
b. Storage and handling requirements and recommendations.
c. Installation methods.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories, including nameplate data and ratings for motors.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
1. Include plans, elevations, sections, details, and attachments to other work. Drawings must show actual wall conditions.
2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Door Sections: 6 inches square.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.4 CLOSEOUT SUBMITTALS:

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
1. Maintenance Data: For sectional doors to include in maintenance manuals.
2. Special manufacturer’s warranty.
3. Special finish warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved for both installation and maintenance of units required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, and UL 325 Standard by a qualified testing agency, and marked for intended location and application.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.
   2. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.
   3. Fold up metal banding, flatten, and place in designated area for recycling.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Faulty operation of hardware.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
      d. Delamination of exterior or interior facing materials.
      e. Failure of components or operators before reaching required number of operation cycles.
   2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products from one of the manufacturers specified.
   1. C.H.I. Overhead Doors
   2. Clopay Building Products, Inc., a Griffon Company
   3. Raynor
   4. Wayne-Dalton Corp.
   5. Overhead Door Corp.
   6. Amarr Garage Doors
   7. Arm-R-Lite
   8. Fimbel Architectural Door Specialties
   9. Martin Door Manufacturing
   10. Rite-Hite Corporation

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain sectional doors from a single source from a single manufacturer.
   1. Obtain operators and controls from the sectional door manufacturer or approved in writing by the sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Sectional doors shall meet performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

B. Operation Cycles: Provide sectional door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

2.3 ALUMINUM DOOR ASSEMBLIES

A. Aluminum Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.

B. Operation Cycles: Door components and operators capable of operating for not less than 10,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.

C. Aluminum Sections: Construct door sections with stiles and rails formed from extruded-aluminum shapes, complying with ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated, with wall thickness not less than 0.065 inch for door section 1-3/4 inches deep. Fabricate sections with stile and rail dimensions and profiles shown on Drawings. Join stiles and rails by welding or with concealed, 1/4-inch minimum diameter, aluminum or nonmagnetic stainless-steel through bolts, full height of door section. Form meeting rails to provide a weathertight-seal joint.
   1. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.
   2. Provide reinforcement for hardware attachment.

D. Full-Vision Sections: Manufacturer's standard, tubular, aluminum-framed section glazing set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.
   1. Tempered Glass: 3mm thick and complying with ASTM C1048, Kind T (fully tempered), Condition A (uncoated), Type I, Class 1 (clear), Quality Q3.

2.4 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Manufacturer's standard, galvanized-steel low-headroom track system, sized for door size and weight, designed for lift type indicated and clearances shown on Drawings, and complying with ASTM A 653 for minimum G60 zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slope tracks at proper angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.

B. Track Reinforcement and Supports: Galvanized-steel track reinforcement and support members, complying with ASTM A 36 and ASTM A 123. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
   1. Vertical Track Assembly: Track with continuous reinforcing angle attached to track and attached to wall with jamb brackets.
   2. Horizontal Track Assembly: Track with continuous reinforcing angle attached to track and supported at points from curve in track to end of track by laterally braced attachments to overhead structural members.

2.5 HARDWARE/SAFETY DEVICES

A. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges where required, for doors over 16 feet wide unless otherwise recommended by door manufacturer.

C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch diameter roller tires for 3-inch-wide track and 2-inch diameter roller tires for 2-inch-wide track.

D. Push/Pull Handles: For emergency-operated doors, provide galvanized-steel lifting handles on each side of door.

E. Safety Devices (Interior)
   1. Provide roller shields, to help to prevent fingers from getting caught by roller in track.
   2. Provide tapered reverse angle mounted tracks, in lieu of standard reverse angle mounted, to keep fingers from reaching in from the outside.
   3. Provide center back-hang and rear back-hanging device in case one would ever fail.

2.6 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
   1. Lock Cylinders: Provide cylinders specified in Division 08 Section "Door Hardware".

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.7 COUNTERBALANCE MECHANISM

A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet long and two additional brackets at one-third points to support shafts more than 16 feet long unless closer spacing is recommended by door manufacturer.

C. Cables: Galvanized-steel lifting cables with cable safety factor of at least 7 to 1.

D. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.

E. Bumper: Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.8 ELECTRIC DOOR OPERATORS, COMMERCIAL

A. door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
   1. Comply with NFPA 70.
   2. Provide control equipment complying with NEMA ICS 1B, unless otherwise noted, NEMA ICS 2, and NEMA ICS 6 at exterior and high-humidity locations, where indicated; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
   3. Safety: Listed in accordance with UL325 by a qualified testing agency for commercial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.
   4. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.

B. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
   1. Jack Shaft, Front Mounted: As standard with manufacturer for application indicated.

C. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 11 Section "Common Motor Requirements for Equipment".
   1. Electrical Characteristics:
      a. Phase
         1) Single phase, provide where capacitor-start type motor is 1/2 hp or less.
            a) Volts: Coordinate wiring requirements with building electrical.
         2) Polyphase, provide where motor is greater than 1/2 hp or required by door manufacturer.
         3) Volts: Coordinate wiring requirements with building electrical system.
      b. Hertz: 60.
   2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
   3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
   4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
   5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
   6. Use adjustable motor-mounting bases for belt-driven operators.

D. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

E. Control Station: Door may open with momentary contact, but must close with sustained or constant pressure, unless otherwise noted.
   1. Interior units, full-guarded, flush-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1B enclosure, “open/close” key switch.

F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's/NOMMA's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
1. If substrate preparation is the responsibility of another installer, notify A/E of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Tracks:
1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches apart.
2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
3. Repair galvanized coating on tracks according to ASTM A 780.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operating Doors: Install according to UL 325.

3.3 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Align and adjust motors, pulleys, belts, sprockets, chains, and controls according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 08 36 13

SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Aluminum-framed storefront (framing) systems.

B. Related Sections:
1. Division 02 Section “Selective Demolition” for selective demolition of existing storefront frame.
2. Division 07 Section “Joint Sealants”: For sealant between aluminum frames and adjacent materials.
3. Division 08 Section “Aluminum Doors”.
4. Division 08 Section “Door Hardware”.
5. Division 08 Section “Glazing”: For glazing requirements.

1.2 PREINSTALLATION MEETINGS

A. Pre-installation Meeting: Conduct meeting a project site in conjunction with door hardware meeting.
1. Agenda
a. Review and finalize construction schedule.
b. Review code and project performance compliance documentation and testing requirements including product certification for energy (U-value, SHGC), ADA, etc.
c. Review means and methods related to installation, including manufacturer’s written instructions.
d. Examine support conditions for compliance with requirements including alignment and attachment to structural members.
e. Review flashings, openings, and conditions of other construction affecting this work.
f. Review temporary protection requirements for during and after installation of this work.

1.3 ACTION SUBMITTALS

A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, finishes, anchorage and fasteners, glazing, and internal drainage.

B. Shop Drawings: For aluminum-framed storefront systems. Show details of fabrication and installation, including plans, elevations, sections, and details of components, provisions for expansion and contraction, and attachments to other work. Drawings must show actual wall conditions.
1. Indicate member sizes, reinforcement and support hardware necessary for a complete installation.
2. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
3. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

4. Transition Details: Include three-dimensional isometric drawings of the frame illustrating how the frame will interface with the transition strip associated with the air barrier in the masonry cavity. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
5. Include point-to-point wiring diagrams showing the following:
    a. Power requirements for each electrically operated door hardware.
    b. Location and types of switches, signal devices, conduit sizes, and number and size of wire.

C. Delegated Design Submittal: For aluminum-framed storefronts including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Indicate member sizes and reinforcement necessary to meet performance requirements and support hardware.
2. Detail fabrication and assembly of aluminum-framed systems, including fastener and fastener locations.
3. Include design calculations to verify compliance with Performance Requirements.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Qualification Data:
1. For installers.
2. For professional engineer's experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Energy Performance Certificates: For aluminum-framed storefront framings accessories and components, from manufacturer, provide a signed and dated certification for the installed fenestration listing the U-factor, SHGC, and the air leakage rate.
1. Provide an NFRC Component Modeling Approach (CMA) generated label certificate shall be provided by the manufacturer. The label certificate shall be project specific and will contain the thermal performance ratings of the manufacturer's framing combined with specified glass and glass spacer used in the fabrication of the glass, at NFRC standard test size as defined in table 4-3 in NFRC 100-2010.

1.5 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
1. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
2. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer and supervisor who has specialized in installing entrance and storefront systems similar to those required for this Project and who is acceptable to manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass and Metal (AGM) contractors.

B. Regulatory Requirements
1. Accessible Entrances: Conform to the U.S. Architectural & Transportation Barriers Compliance Board's, "Americans with Disabilities Act Accessibility Guidelines" (ADAAG) and State and Local Regulations. These requirements supersede Technical Specifications in this Section.
    a. Opening-Force Requirements:
        1) Egress Doors: Not more than 30 lbf required to set door in motion and not more than 15 lbf required to open door to minimum required width.
        2) Accessible Interior Doors: Not more than 5 lbf.

C. Mockups: Building mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build mockup in conjunction with mockup indicated as part of Division 04 Section “Unit Masonry”. First installation of aluminum-framed entrances and storefronts, including glazing may serve as mockup. Coordinate location with A/E.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless A/E specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Materials to be packed, loaded, shipped, unloaded, stored and protected in accordance with AAMA C101-10.

B. Do not used adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

C. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of this Work to be performed according to manufacturer’s installation instructions and warranty requirements.
   1. Install sealant according to sealant manufacturer guidelines.

B. Field Measurements: Check openings by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the work.

1.9 SYSTEM REQUIREMENTS

A. Design Requirements
   1. Drawings are diagrammatic and do not purport to identify or solve problems of thermal or structural movement, glazing, anchorage, or moisture disposal.
   2. Requirements shown by details are intended to establish basic dimensions of units, lines and profiles of members.
   3. Provide concealed fastening.
   4. Provide entrance and storefront systems, including necessary modifications, to meet specified requirements and maintain visual design concepts.
   5. Attachment considerations are to take into account site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening or fracturing connection between units and building structure or between units themselves.
   6. Provide for expansion and contraction due to structural movement without detriment to appearance of performance.
   7. Framing systems shall accommodate expansion and contraction movement due to surface temperature differentials of 180 degrees without causing buckling, stress on glass, failure of joint seals, excessive stress on structural elements, reduction of performance, or other detrimental effects.

1.10 WARRANTY

A. Special Assembly Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
   1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals, metal finishes (unless special finish warranty is required), and other materials beyond normal weathering.
d. Water leakage through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, or chipping.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for Architect/Engineer's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain all components of aluminum-framed storefront system, including framing and accessories, from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacturer, fabrication, installation, or other defects in construction.

1. Aluminum-framed storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.
3. Transition of the AWB assemblies and fenestration needs to align as close as possible.
4. Connection shall accommodate anchors, shims, adjustments, and building movement maintaining continuity of the building envelope AWB.
5. Avoid thermal "short circuits" and align thermal breaks in fenestration with surrounding wall insulation to optimize energy performance.

B. Glazing: Physically and thermally isolate glazing from framing members.

C. Structural Loads
   1. Wind Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding wind load design pressures calculated according to requirements of authorities having jurisdiction or the American Society of Civil Engineers' ASCE 7, "Minimum Design Loads for Buildings and Other Structures," "6.5, Method 2 - Analytical Procedure," whichever are more stringent.
      a. Basic Wind Speed: 115 mph.
      b. Importance Factor: 1.15.
      c. Exposure Category: D.
      d. Building Classification: III, unless otherwise noted.

D. Deflection of Framing Members: At design wind pressure, as follows:
   1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
   2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing tile to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

E. Structural: Test according to ASTM E330 as follows:
   1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceed 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E283 or NFRC 400 for infiltration as follows:
   1. Fixed Framing and Glass Area
      a. Maximum air leakage of 0.06 cfm/sq.ft. at a static-air-pressure differential of 1.57 lbf/sq.ft.
   2. Entrance Doors
      a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq.ft. at a static-air-pressure differential of 1.57 lbf/sq.ft.
      b. Single Doors: Maximum air leakage of 0.5 cfm/sq.ft. at a static-air-pressure differential of 1.57 lbf/sq.ft.

G. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq.ft.

H. Energy Performance: Certify and label energy performance according to NFRC as follows:
   1. Thermal Transmittance (U-factor):
      a. Type II (Non-Thermally Broken Frames): Entrance door framing shall have U-factor of not more than 0.63 Btu/sq.ft. x h x deg F.
      b. Type IV (Thermally Broken): Fixed glazing and framing areas shall have U-factor of not more than the following as determined according to NFRC 100.
         1) Operable: 0.45 Btu/sq.ft. x h x deg F.
         2) Fixed: 0.36 Btu/sq.ft. x h x deg F.
   2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than as determined according to NFRC 200.
      a. Entrance Door: 0.33
      b. Fixed: 0.36

3. Labeling of Fenestration Products: All manufactured fenestration products shall have a permanent nameplate, installed by manufacturer, listing the U-factor, SHGC, and air leakage rate.
    a. When the fenestration product does not have such nameplate, the installer or supplier of such fenestration shall provide a signed and dated certification for the installed fenestration listing the U-factor, SHGC, and air leakage rate.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F., ambient; 180 deg F., material surfaces.

J. Dimensional Tolerances: Provide window and storefront systems that accommodate dimensional tolerances of building frame and other work.

2.3 STOREFRONT SYSTEMS

A. Framing members, transition members, mullions, sills, adapters, and mountings (including sill anchors, frame receptors at jambs, and other frame trim and accessories shown on Drawings), and as required to meet Performance Requirements, shall be extruded aluminum with alloy and temper consistent with the method of manufacturer.
1. Framing members shall be of thickness required and reinforced as required to support imposed loads.
2. Construction: Where indicated, members shall incorporate a thermal-barrier by one of the following methods:
    a. Framing members shall be composite assemblies of two separate extruded-aluminum components permanently bonded by an elastomeric material of low thermal conductance.
    b. High-performance plastic connectors separate framing members exposed to the exterior from members exposed to the interior.
3. Glazing System: Retained mechanically with gaskets on four sides.
4. Glazing Plane: Center.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

B. Type II – 2 by 4-1/2 inch. Framing members shall provide for flush center glazing of one inch insulating glass, by use of elastomeric gaskets on both sides of the glass, with no projecting stops. Vertical and horizontal framing members shall have a nominal face dimension of 2 inches with an overall depth of 4-1/2 inches. Entrance framing members shall be compatible with glass framing in appearance. Single acting entrance frames shall include weatherstripping.
1. Manufacturers: Subject to compliance with requirements, provide one of the manufacturers specified:
    a. Series 402; EFCO Corporation a subsidiary of Apogee Framing Systems
    b. Trifab VG 451; Kawneer Co.
    c. 14000 (Non-Thermally Improved); Tubelite a subsidiary of Apogee Framing Systems
    d. YES 45FS; YKK AP America
    e. 451 Series; U.S. Aluminum Div. of CRL
    f. FG-3000; Oldcastle Building Envelope (OBE)
2. Application for framing type
    a. Interior vestibule doors.

C. Type IV – 2-1/4 (nominal) by 4-1/2 inch (High Performance). Framing members shall provide for flush center glazing up to one inch. Screw spline assembly.
1. Manufacturers: Subject to compliance with requirements, provide one of the manufacturers specified:
    a. YES 45FT/YES 45XT; YKK AP America
    b. System 403-I; EFCO Corp. a subsidiary of Apogee Framing Systems

c. Trifab VG 451UT; Kawneer
d. ArmorOne Plus; Oldcastle Building Envelope (OBE)
e. TU24000 Series Storefront; Tubelite a subsidiary of Apogee Framing Systems

2. Application for framing type
a. Entries.
b. Exterior storefront system (punched openings).

D. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.

2.4 GLAZING

A. Glazing as specified in Division 08 Section "Glazing" and "Security Glazing".

B. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.

C. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.

D. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.

E. Sealants and joint fillers for joints at perimeter of entrance and storefront systems as specified in Division 07 Section "Joint Sealants".

F. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; neutral-curing silicone formulation compatible with structural sealant and other system components with which it comes in contact; and recommended by sealant and aluminum-framed system manufacturer for this use.
1. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluating of Volatile Organic Chemical Emissions form Indoor Sources Using Environmental Chambers".

2.5 HARDWARE

A. Refer to Division Section "Door Hardware", unless otherwise noted.
1. Refer to Door Sections for continuous or pivot hinges.
2. Hardware shall be sent to the door and frame manufacturer for application. The finish hardware supplier shall be responsible for furnishing physical hardware and templates of hardware to the entrance door and frame manufacturer prior to fabrication and for coordination hardware delivery requirements with the hardware manufacturer.

B. Weather Stripping: Manufacturer's standard replaceable components.
1. Compression Type: Mode of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.

C. Silencers: BHMA A156.16, Grade 1.

2.6 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below:
   1. Sheet and Plate: ASTM B209.
   2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B221.
   3. Extruded Structural Pipe and Tubes: ASTM B429.
   4. Bars, Rods, and Wire: ASTM B211.
   5. Welding Rods and Bare Electrodes: AWS A5.10.
   6. Structural Profiles: ASTM B308.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC Standard.
   1. Structural Shapes, Plates, and Bars: ASTM A 36.
   2. Cold-Rolled Sheet and Strip: ASTM A 1008.
   3. Hot-Rolled Sheet and Strip: ASTM A 1011.

2.7 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
   2. Reinforce members as required to receive fastener threads.
      a. Provide a backup reinforcement, at door frame head, of steel or 1/4 inch aluminum for attachment of closer arm.
      b. All members less than 0.125 inch thick to receive threaded fasteners shall receive backup reinforcement.

B. Anchors: Three-way adjustable anchors with minimum adjacent of 1 inch that accommodate fabrication and finish compatible with adjoining materials and recommended by manufacturer.
   1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

D. Vertical mullions between doors shall have steel reinforcement and be attached to the floor with concealed fasteners.

E. Subsills: Thermally broken, extruded-aluminum subsills.
   1. Provide at all storefront assemblies above first floor line (grade).

F. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30 mil thickness per coat.

G. Transition Membrane: To maintain the air and water barrier a pre-formed silicone sheet or manufacturer approved flexible flashing of stainless steel core with polymer fabric laminated to bottom stainless steel face with non-asphalt adhesive.
   1. Basis-of-Design: Multi-Flash SS; York Manufacturing or a comparable product by one of the following:
      a. IPCO Stainless Steel Fabric Flashing; Illinois Products Inc.
      b. R-Guard SS ThruWall; Prosoco, Inc.
      c. Wall Guardian Stainless Steel TWF; STS Coatings, Inc.
      d. TK TWF; TK Products, Inc.

2.8 FABRICATION

A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
   4. Physical and thermal isolation of glazing from framing members.
   5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
      a. Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual".
   6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or panels.
   7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
   8. Where aluminum will contact dissimilar metals, protect against galvanic action.
   9. Reinforce work as necessary for performance requirements and for support to structure.
   10. Seal horizontals and direct moisture accumulation to exterior.
   11. Maintain accurate relation of planes and angles, with hairline fit of contracting members.
   12. Provide flashings and other materials used internally or externally that are corrosive resistant, non-staining, non-bleeding and compatible with adjoining materials.

B. Form or extrude aluminum shapes before finishing.

C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

E. Storefront Framing: Fabricate components for assembly using screw-spline system or head and sill receptor system with shear blocks at intermediate horizontal members.
   1. Factory assemble components to greatest extent possible. Dissemble components only as necessary for shipment and installation.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
   1. At exterior and interior doors, provide compression weather stripping at fixed stops.
   2. Provide subframes and reinforcing of types indicated or, if not indicated, as required for complete system.
   3. Where aluminum doors are scheduled to receive a concealed overhead stop, the jamb bracket shall be mortised into the frame and the channel mortised into the top of the door. The cut for the arm on the stop side of the door shall not be cut below the stop strip of the frame.

G. After fabrication, clearly mark components to identify their locations in Project according to shop drawings.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and top for factory-installed entrance door hardware before applying finishes.

2.9 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within 1/2 of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

D. Color Anodic Finish: AAMA 611-20, AA-M12C22A44 or AA-M10C21A44, Class I, 0.018 mm or thicker.
   1. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Openings for aluminum entrances shall be prepared to the proper size, plumb, square, level, and in the proper location and alignment as shown on the Drawings and the final shop drawings.
   1. Coordinate with masonry tolerances. Refer to Division 04 Section “Unit Masonry”.

3.3 INSTALLATION

A. General: Comply with manufacturer’s written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
   1. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
   2. Shim and brace aluminum system before anchoring to structure.
   3. Provide sill flashing at exterior storefront systems. Extend extruded flashing continuous with splice joints; set in continuous beads of sealant.
   4. Verify storefront system allows water entering system to be collected in gutters and wept to exterior.
   5. Locate expansion mullions where indicated on reviewed shop drawings.
   6. Seal perimeter and other joints watertight, unless otherwise indicated.
      a. Do not seal weeps.
   7. Locate sealant to maintain the continuity of the air and water barrier. The sealant installed at the exterior face is a weather seal.
      a. When it is not possible to install sealant in the recommended location a transition membrane can be used.

B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.
   1. Provide end dams at all sill terminations.

D. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction, unless otherwise indicated. Comply with requirements of Division 07 Section “Joint Sealants”.
   1. To minimize the potential for water leakage attributed to the subsill, fastener penetrations through the horizontal leg of the subsill should be avoided. Instead, brackets that engage the subsill without penetrating the wet zone should be mechanically attached to the subsill extrusion and fully sealed to ensure a watertight interface.
   2. Exterior Flashing Receivers: Install in accordance with manufacturer’s recommendations, approved submittals and in proper relationship with adjacent construction. Includes the following:
      a. Secure receiver at perimeter of wall opening with adhesives or fasteners.
      b. Place flashing into receiver channel.
      c. Secure flashing with receiver clip.

E. Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.

F. Install entrances plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers’ written instructions.
   1. Install surface-mounted hardware according to manufacturer’s written instructions using concealed fasteners to greatest extent possible.

G. Install glazing to comply with requirements of Division 08 Section “Glazing”, unless otherwise indicated.
   1. Prepare surfaces that will contact structural sealant according to sealant manufacturer’s written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

H. Install perimeter sealant to comply with requirements of Division 07 Section “Joint Sealants”, unless otherwise indicated.

I. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:
   1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
   2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
   3. Alignment:
      a. Where surface abut in line or are separated by a reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
      b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
      c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
   4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

J. Do not cut aluminum frame stop strip when mounting exit devices and closers.

K. Coordinate with Division 08, Division 26, and security access contractor for location and installation of conduit/wiring required for electrified hardware items mounted to doors and frames, including, but not limited to, cutting/drilling any access holes required for pulling wires through frame head/jambs to the electrified hardware items.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08 43 13

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Automatic operators.
4. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 01 Section "General Conditions”.
2. Division 06 Section “Rough Carpentry”.
3. Division 06 Section “Finish Carpentry”.
4. Division 08 Section “Operations and Maintenance”.
5. Division 08 Section “Hollow Metal Doors and Frames”.
6. Division 08 Section “Flush Wood Doors”.
7. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
8. Division 08 Section “Automatic Door Operators”.
9. Division 26 Section "Electrical”

D. Codes and References: Comply with the version adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
8. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.

3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

    a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    b. Complete (risers, point-to-point) access control system block wiring diagrams.
    c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 MATERIALS

A. Hardware shall not have any visible manufacturer names on exposed materials, except cylinders, when the door is in a closed position.

2.3 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

   a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.

5. Manufacturers:

   a. Hager Companies (HA) - BB Series, 5-knuckle.
   b. McKinney (MK) - TA/T4A Series, 5-knuckle.
   c. dormakaba BEST (ST) - F/FBB Series, 5-knuckle.

2.4 CONTINUOUS HINGES

A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Where specified, provide modular continuous geared hinges that ship in two or three pieces and form a single continuous hinge upon installation.
2. Manufacturers:.

   a. Hager Companies (HA).
   b. Pemko (PE).
   c. Select Hinges (SL).

2.5 POWER TRANSFER DEVICES

A. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

    a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
    b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

    a. Hager Companies (HA) - Quick Connect.
    b. McKinney (MK) - QC-C Series.
    c. Schlage (SC) - Connect.
    d. dormakaba BEST (ST) - WH Series.

2.6 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Rockwood (RO).
    c. Trimco (TC).

2.7 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

1. Manufacturers:

    a. Schlage (SC).
    b. Match Existing, Field Verify.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Match Facility Standard.

C. Large Format Interchangeable Cores: Provide removable cores (LFIC) as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Control Keys (where required): Two (2).
4. Permanent Control Keys (where required): Two (2).

F. Construction Keying: Provide temporary keyed construction cores.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.8 CYLINDRICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide locksets with functions and features as follows:

a. Meets ANSI/BHMA A156.41 for single motion egress.
b. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
c. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
d. Exceeds ANSI/BHMA A156.2 requirements by 2.6 times for 3,100 in-lb. abusive locked lever torque with no entry while maintaining egress.
e. Exceeds ANSI/BHMA A156.2 requirements by 8 times for 1,600 lbs. offset lever pull with no entry for protection against attacks.
f. Exceeds ANSI/BHMA A156.3 requirements by 2 times for latch retraction with 100 lb. preload while maintaining operation in warped doors.

g. Exceeds ANSI/BHMA A156.3 requirements by 20 times for no access with minimum 100 vertical impacts for protection against vandalism attempts.
h. Independent return springs allow lock to exceed ANSI/BHMA A156.2 Grade 1 cycle requirements without lever sag.
i. Ten-year limited warranty for mechanical functions.

2. Manufacturers:

a. Schlage (SC) - ND Series.
b. No Substitution.

2.9 DEADLOCKS AND LATCHES

A. Cylindrical Deadlocks: ANSI/BHMA A156.36 Grade 1 Certified Products Directory (CPD) listed deadlocks to fit standard ANSI 161 preparation. Provide tapered collars to resist vandalism and 1" throw solid steel bolt with hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

1. Manufacturers:

a. Schlage (SC) - B600 Series.
b. No Substitution.

2.10 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.11 ELECTRIC STRIKES

A. Standard Electric Strikes: Electric strikes conforming to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability with field selectable fail-secure/fail-safe. Where specified provide latchbolt monitoring indicating both the position of the latchbolt and locked condition of the strike.

1. Manufacturers:

a. HES (HS) - 5000/5200 Series.

B. Heavy-Duty Electric Strikes: Electric strikes conforming to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings designed to accommodate pre-load on fail secure models. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability with field selectable fail-secure/fail-safe and where specified provide latchbolt monitoring.

1. Manufacturers:

a. HES (HS) - 7000/7500 Series.

C. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

2.12 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.
10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

a. Von Duprin (VD) - 35A/98 XP Series.
b. No Substitution.

2.13 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Manufacturers:

a. LCN Closers (LC) - 4040XP Series.
b. No Substitution.

2.14 ELECTROHYDRAULIC DOOR OPERATORS

A. Electrohydraulic Door Operators (High Traffic): Provide ANSI/BHMA A156.19 Certified Products Directory (CPD) listed low energy operators that meet ANSI/BHMA A156.4 requirements and are UL listed for use on fire rated doors and UL10C certified that comply with requirements for the Americans with Disabilities Act (ADA). Operators shall be verified by GreenCircle to offer energy savings of 19% when compared to similar products to accommodate openings up 250 pounds and 48” wide. Provide accessories such as custom templates, special mounting brackets, spacers and drop plates as needed for proper installation. Operators shall accommodate openings up to 200 pounds and 48” wide. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide operators with features as follows:

    a. Non-handed with push and pull side mounting.
    b. Operates as mechanical surface closer during close cycles, when door is opened manually or if power is off.
    c. Activation by push button, hands-free or radio frequency devices.
    d. On board electronics to collect usage and cycle count data to facilitate preventative maintenance/diagnostics.
    e. Two-year limited warranty.
    f. Wi-Fi interface where the operator is a secure, password protected WiFi hot spot with no connection to building's IT required.
        1) Simple setup with no app required.
        2) View status and make adjustments without removing the cover.
        3) Built-in logic to support single use restroom applications with no external relay boards, logic modules, position switches required.
    g. Mounting backplate to simplify and speed up installation.

2. Operators shall have the following functionality:

    a. Adjustable Hold Open: Amount of time a door will stay in the full open position after an activation.
    b. Blow Open for Smoke Ventilation: Door opens when signal is received from alarm system allowing air or smoke to flow through opening. Door will stay open until signal from alarm system is stopped.
    c. Infinite Hold Open: Door will hold open at set position until power is turned off.
    d. Obstruction Detection: Door closes if it hits an obstruction while opening; door will reverse to open position if it hits an obstruction while closing. Door will stop once it hits an obstruction and will rest against the obstruction until removed.
    e. Open Delay: Delays operator opening for locking hardware.
    f. Overload Safety Shut-Off: After two minutes of receiving a door activation signal, inverter times out and door closes to prevent motor/inverter damage.
    g. Presence Detector Input: Input for external sensor to detect presence at door open or close position only.
    h. Push & Go: As the door is manually opened, the operator "senses" movement and opens door to the full-open position.
    i. Selector Mode Switch: Off disables the signal inputs unless Blow Open is activated, on activates the signal inputs, hold open activates the unit (unless Blow Closed is activated) to the hold open position.
    j. Vestibule Delay: When the wall switch is pressed, first door in vestibule will open. Second door will open once vestibule door delay has expired. Delay is adjustable.

3. Manufacturers:

a. LCN (LC) - 4630/4640 Series.
b. Norton Rixson (NO) - 6000 Series.

2.15 DOOR STOPS AND HOLDERS

A. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Burns Manufacturing (BU).
b. Rockwood (RO).
c. Trimco (TC).

B. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. dormakaba (DO).
b. Norton Rixson (NO).

2.16 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko (PE).
3. Reese Enterprises, Inc. (RE).

2.17 ELECTRONIC ACCESSORIES

A. Intelligent Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Power supplies shall meet all functions and features as specified herein.

a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
b. Dedicated fast charger to prolong battery life with low battery cutoff to protect batteries from deep discharge.
c. Enhanced surge immunity for input/output protection
d. Separate, dedicated battery charging circuit to keep locks cooler.
e. Dual-color LED visual notification to prevent applying incorrect voltages to the power supply.
f. Instant auto-switch to battery on AC loss.
g. Expandable up to 16 outputs in the standard enclosure
h. Integrated fire alarm interface to allow main output shutdown or disconnect on a per output basis when using an R8 output module.
i. Network ready and remotely manage locks and connected devices when using an M8 managed output module on network models.
j. Lifetime replacement, no-fault, no questions asked warranty.

2. Manufacturers:

a. Life Safety Power (LP).
b. Securitron (SU) - AQL Series.

2.18 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.19 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Paint prime coated mullions to match frames.

C. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

D. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

E. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

F. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

G. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Refer to Section 08 06 71, Door Hardware Sets, for hardware sets.

END OF SECTION 08 71 00

SECTION 08 80 00 – GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Storefront framing.
   2. Glazed entrances.
   3. Interior borrowed lites.

B. Related Sections include the following:
   1. Division 08 Section “Aluminum Doors” for thermal performance requirements.
   2. Division 08 Section “Aluminum-Framed Storefront” for thermal performance requirements.

1.2 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters (mm) according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Solar Heat Gain Coefficient (SHGC): The ratio of the solar heat gain through the glass relative to the incident solar radiation. Solar heat gain includes both direct and indirect gain. The direct gain is the solar energy directly transmitted through the glazing. The indirect gain is the solar energy absorbed by the glazing and subsequently convected and thermally radiated inward.

E. Low-Emissivity (“Low-E”): Having the demonstrated ability to reduce heat gain or loss by reflecting long-wave infra-red (IR) energy (heat), thereby decreasing the U-value and improving energy efficiency.
   1. “Solar-Control” Low-E Glazing: Glazing that has a SHGC equal to or less than 0.40. Solar-control low-e coatings maximize the amount of daylight transmitted through the glass while minimizing both the amount of solar heat transmitted into the building and the amount of heat loss from the long-wave infrared portion of the heat spectrum.

F. Sealed Insulating Glass Unit Surface Designations:
   1. Surface 1 – Exterior surface of the outer glass lite.
   2. Surface 2 – Interspace surface of the outer glass lite.
   3. Surface 3 – Interspace surface of the inner glass lite.
   4. Surface 4 – Interior surface of the inner glass lite.

G. Outer Lite: The glazing pane facing the exterior of the building or away from the room or space.

H. Inner Lite: The glazing pane facing the interior of the building or into the room or space.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances and adequate sealant thicknesses, with reasonable to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 PRE-INSTALLATION MEETINGS

A. Pre-installation Meeting: Conduct meeting at Project site.
   1. Conduct in conjunction with “opening” meetings.
   2. Review and finalize construction schedule and verify availability of materials, Installer’s personnel, equipment, and facilities needed to make progress and avoid delays.
   3. Review temporary protection requirements for glazing during and after installation.

1.5 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each glass type and glazing material required, including installation and maintenance instructions.

B. Shop Drawings: Indicate required face and edge clearances and recommended edge sealants, if not identified in Product Data.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Performance Requirement Verification: Provide verification that installation of products will result in compliance with “Performance Requirements” indicated. This may include: calculations, testing results, manufacturer installation and attachment requirements, fastener information for indicated substrate, or other means necessary to demonstrate compliance.

1.6 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
   1. For solar-control low-e coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.
   2. Glazing materials contain less than one-percent asbestos by weight (mass).
   3. Insulating glass meets CBA Standards or proof of certification.

B. Qualification Data:
   1. For fabricators of insulating-glass units with sputtered low-e coatings.
   2. For installers.

1.7 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Warranties: Special warranties specified in this Section.

1.8 QUALITY ASSURANCE

A. Qualifications
   1. Fabricator Qualifications for Insulating-Glass Units: Fabricator must be capable of producing certified sealed insulating-glass products equivalent to “CBA” level. Fabricators must be listed in the IGCC directory or submit evidence of quality-assurance program. The quality-assurance program, as a minimum, must have the following elements:
      a. A quality manual.
      b. Operating procedures documenting how insulating-glass units are fabricated.
      c. A designated person responsible for quality assurance.
      d. Routine product or component checks.
   2. Installer Qualifications: An experienced installer who has completed glazing similar in material design and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.

a. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass and Metal (AG&M) contractors.

3. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC's CAP 1 Certification Agency Program.
4. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

B. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of Insulating Glass Certification Council (IGCC).

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
1. Install glazing in mockups specified in Division 08 Section(s) "Aluminum-Framed Entrances and Storefronts" and "Glazed Aluminum Curtain Walls" to match glazing systems required for Project, including glazing methods.
2. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturers and fabricator's written instructions. Prevent damage to glass and glazing materials from:
1. Condensation.
2. Temperature changes.
3. Direct exposure to sun.
4. Other causes.
a. Primary seal protection: Follow manufacturer/fabricator protocols to minimize the risk for damage to, or failure of, the primary IG unit seal caused by shearing stresses during handling and storage.
b. Avoid glass-to-glass contact: Guard against latent damage to large IG units caused by glass-to-glass contact when subject to changes in temperature and/or barometric pressure.
5. Protect from contact with corrosive chemicals.
6. Avoid placement of glass edge on concrete, metal, or other hard objects.

B. For insulating-glass units that might be exposed to substantial altitude changes, comply with insulating-glass fabricator's written recommendations for venting and sealing units to avoid hermetic seal ruptures.

C. Deliver glass to site in suitable containers that will protect glass from the weather and from breakage. Carefully store material, as directed, in a safe place where breakage can be reduced to a minimum. Deliver sufficient glass to allow for normal breakage. Glazing compounds shall arrive at the project site in labeled containers that have not been opened.
1. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coating on glass.

D. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.
2. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.
3. Fold up metal banding, flatten, and place in designated area for recycling.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.11 WARRANTY

A. General: Warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

B. Insulating Glass: Fabricator's standard form in which insulating-glass fabricator agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributable to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions.
   1. Evidence of failure is the obstruction of vision by:
      a. Dust.
      b. Moisture.
      c. Film on interior surfaces of glass.
   2. Glass breakage due to thermal stress will be replaced by the Contractor at no additional cost to the Owner during the guarantee period.
   3. Warranty Period: Manufacturer's/fabricators standard but not less than 10 years after date of Fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following:
   1. Defective manufacture, fabrication, or installation.
   2. Failure of sealants or gaskets to remain watertight and airtight.
   3. Deterioration of glazing materials.
   4. Other defects in construction.

B. Reference Standards: Perform work according to standards specified and as follows, unless modified by requirements in Contract Documents.
   1. Make available via internet access or maintain on site a copy of each standard affecting the work of this Section.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
   1. Change in Ambient Temperature: 120 degrees Fahrenheit
   2. Change in Temperature of Material Surfaces: 180 degrees Fahrenheit

D. Regulatory Requirements:
   1. Safety Glazing: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.

a. Subject to compliance with requirements, permanently mark safety glazing with certification label of Safety Glazing Certification Council (SGCC) or another certification agency acceptable to authorities having jurisdiction.
1) Identification on tempered glass shall include the words “Tempered Safety Glass”.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified and required by Opening Manufacturer to meet requirements, as indicated in manufacturer’s published test data, based on procedures indicated below:
1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
2. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBNL’s WINDOW 6.3 computer program, expressed as Btu/sq.ft. x h x deg F.
3. Solar Height-Gain Coefficient and Visible Transmittance: Center of glazing values, according to NFRC 200 methodology and based on LBNL’s Window 6.3 computer program.
a. Solar Heat Gain Coefficient: Shall not be greater than the following:
1) Fixed: 0.38
2) Operable: 0.33

2.3 FABRICATORS

A. Fabricators of Glass: Subject to compliance with requirements, provide products by one of the fabricators listed as certified with IGCC or meeting “Quality Assurance” requirements.

2.4 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass manufacturers, glass product fabricators, and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. Glass Association of North America (GANA):
a. Glazing Manual (2009).
b. Sealant Manual (2008).
2. American Architectural Manufacturers Association (AAMA):
a. Glass Design for Sloped Glazing (AAMA GDSG-1-87).
b. Sloped Glazing Guidelines (AAMA TIR-A7-83).
3. Insulating Glass Manufacturers Alliance (IGMA):
a. SIGMA TM-3000 “Glazing Guidelines for Sealed Insulating Glass Units”.
b. IGMA Guidelines for Sloped Glazing (IGMA TB-3001-01).

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer’s name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IgCC.

2.5 PERFORMANCE VALUES FOR SPECIFIC INFORMATION

A. Coated Float Glass:
1. Low-E Coating without Reflective Coating:
a. Sputtered Low-E Coating (Performance Level Four):
1) On Surface No. 2: Provide clear 25-mm thick insulating glass with sputtered low-e coating on Surface No. 2 meeting the following performance values. Basis-of-Design: Solarban 70XL by Vitro Glass (fka PPG Flat Glass).

Tint Color	Visible Light Transmittance	Outdoor Visible Light Reflectance	U-Value Winter	Shading Coefficient	SHGC	Light to Solar Gain (LSG)
Clear Starphire plus Solarban 70XL	61-66%	9-14%	0.26-0.31	0.29-0.34	0.25-0.29	2.35-2.39

2.6 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality q3 (glazing select), Class 1 (clear).

B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated. Performance requirements:
      a. Distortion Tolerance: Roll wave peak-to-valley (PV) not to exceed 0.003 center/0.008 edges.
      b. Millidiopter: 90 percent of surface not to exceed +/- 120 millidiopters.
      c. Monitoring: Every lite measured with an on-line distortion measurement system.
      d. Bow/Warp Tolerance: Maximum tolerance for bow/warp is 1/2 of ASTM C 1048.
      e. All documentation recorded and may be available upon request.

C. Wired Glass: Not acceptable.

D. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum-deposition process after manufacture and heat-treatment (if any) and complying with other requirements specified.
   1. Kind: Kind CV (coated vision glass).
      a. Exception where the lower edge of the glass is more than 6 feet above the adjacent floor level or cannot be approached closer than 10 feet: Kind CO (coated overhead glass).

2.7 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
   1. Provide Kind-FT (fully tempered) glass lites.
   2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

B. Sealing System: Dual-seal, with manufacturer’s standard primary and secondary.

C. Spacer: Warm-edge technology, stainless steel and low conductivity thermoplastic.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Super Spacer by Edgetech; a Quanex Building Products Co.
      b. Thermix; a brand of Ensinger USA.
      c. Technoform Glass Insulation, TGI-Spacer Division.
      d. Viracon Thermal Spacer
      e. Azo-Core; AZON

D. Desiccant: Molecular sieve or silica gel, or blend of both.

2.8 GLASS USAGE

A. General: Hereinafter are the minimum glazing requirements. Adjust sealed space, spacer, and coating as required to meet opening performance requirements. Glass shall be as required by opening manufacturer to meet thermal requirements as documented in manufacturer's published test data or verified with testing prescribed.

B. Exterior:
   1. Glass for Exterior Doors and Storefront Glazing:
      a. 25-mm thick fully tempered safety insulating glass consisting of 6.0-mm thick, minimum, clear outer panel, a 13-mm wide hermetically sealed air or gas as required to meet opening "Performance Requirements". space, and 6.0-mm thick, minimum, clear inner panel and shall be factory-installed.
         1) Provide low-e coating on second surface as required to meet opening "Performance Requirements".

C. Interior:
   1. Glass for Vestibule Doors, Sidelights, and Transoms: 6-mm thick clear tempered safety glass, unless otherwise noted.
   2. Glass for Interior Doors and Windows: 6-mm thick clear tempered glass.

2.9 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
   1. EPDM, ASTM C 864.
   2. Silicone, ASTM C 1115.
   3. Thermoplastic polyolefin rubber, ASTM C 1115.

B. Soft Compression Gaskets:
   1. Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below, complying with ASTM C 509, Type II, black, and of profile and hardness required to maintain watertight seal:
      a. EPDM.
      b. Silicone.
      c. Thermoplastic polyolefin rubber.
   2. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.10 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:
   1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.
   4. Colors of Exposed Glazing Sealants: As selected by A/E from manufacturer's full range.

5. Glazing materials brought on site shall contain less than one percent asbestos by content.

B. Elastomeric Glazing Sealant Standard (Weatherseal): Comply with ASTM C 920 and other requirements indicated for each liquid-applied, chemically curing sealant, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

1. Low-Modulus Neutral-Curing Silicone Glazing Sealant (ASTM C 920, Type S, Grade NS, Class 100/50, Use NT):
   a. 790 by Dow Corning Corp.
   b. Bondaflex Sil 290 by May National Associates, Inc.; a subsidiary of Sika Corporation.
   c. Silpruf LM SCS2700 by Momentive Performance Materials Inc., Apollo Management, LP (fka GE Sealants and Adhesives).
   d. 890 by Pecora Corp.
   e. PSI-641 by Polymeric Systems, Inc., Whitford Worldwide.
   f. Spectrem 1 by Tremco Sealant/Weatherproofing Division, RPM International Inc.
2. Medium-Modulus Neutral-Curing Silicone Glazing Sealant (ASTM C 920, Type S, Grade NS, Class 50, Use NT):
   a. Omniseal 50 by MBCC Group.
   b. 756-SMS, 791, 795, or 995 by Dow Corning Corp.
   c. Bondaflex Sil 295 by May National Associates, Inc.
   d. SilGlaze II SCS2800, Silpruf NB SCS9000, Silpruf SCS2000, or UltraPruf II SCS2900 by Momentive Performance Materials Inc., Apollo Management, LP (fka GE Sealants and Adhesives).
   e. 864, 895, 895NST, or 898 by Pecora Corp.
   f. PSI-641 by Polymeric Systems, Inc., Whitford Worldwide.
   g. SikaSil-C995 by Sika Corp. (USA).
   h. Spectrem 2 or Spectrem 3 by Tremco Sealant/Weatherproofing Division, RPM International Inc.
3. High-Modulus Neutral-Curing Silicone Glazing Sealant (ASTM C 920, Type S, Grade NS, Class 25, Use NT):
   a. 799 by Dow Corning Corp.
   b. Bondaflex Sil 200 GPN and Bondaflex Sil 201 FC by May National Associates, Inc.
   c. UltraGlaze SSG4000 or UltraGlaze SSG4000AC by Momentive Performance Materials Inc., Apollo Management, LP (fka GE Sealants and Adhesives).
   d. PSI-631 by Polymeric Systems, Inc., Whitford Worldwide.
   e. PolyGlaze Plus (SM5731) by Schnee-Moorehead (S-M) Division, Illinois Tool Works (ITW) Inc.
   f. Proglaze SSG or Tremsil 600 by Tremco Sealant/Weatherproofing Division, RPM International Inc.
4. High-Modulus Acid-Curing Silicone Glazing Sealant (ASCTM C 920, Type S, Grade NS, Class 25, Use NT):
   a. OmniPlus by MBCC Group.
   b. Chem-Calk 1200 by Bostik Construction Products Division, Bostik Findley Unit of TotalFinaElf.
   c. 999-A by Dow Corning Corp.
   d. Sil 100 GC, Sil 100 GP, or Sil 100 WF by May National Associates, Inc.
   e. Contractors SCS1000 or SCS1200 by Momentive Performance Materials Inc., Apollo Management, LP (fka GE Sealants and Adhesives).
   f. 860 by Pecora Corp.
   g. PSI-601 by Polymeric Systems, Inc., Whitford Worldwide.
   h. PolyGlaze (SM5732) by Schnee-Moorehead (S-M) Division, Illinois Tool Works (ITW) Inc.
   i. Proglaze or Tremsil 200 by Tremco Sealant/Weatherproofing Division, RPM International Inc.

2.11 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent, non-staining and non-migrating in contact with non-porous surfaces, with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated, packaged on rolls with a release paper backing, and complying with ASTM C 1281 and AAMA 800 for products indicated below:
   1. AAMA 804.3 tape, where indicated.
   2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
   3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, polyvinyl-chloride (PVC) foam tapes, factory-coated with adhesive on both surfaces, and complying with AAMA 800 for the following types:
   1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
   2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.12 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation. .

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Silicone material with a Shore, Type A durometer hardness of 85, plus-or-minus 5.
   1. Type recommended by sealant or glass manufacturer.

D. Spacers: Neoprene blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Silicone material of hardness needed to limit glass lateral movement (side walking).
   1. Type recommended by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise optimum glazing sealant performance.

2.13 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
   1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
      a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

D. Tempered Glass: Cut float glass materials to indicated sizes and provide cut-outs and holes, if indicated, before heat strengthening.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine glass framing, channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep system.
   3. Minimum required face and edge clearances.
   4. Effective sealing between joints of glass framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION FOR GLAZING

A. Clean the glazing channel or other framing members to receive glass, immediately before glazing. Remove coatings that are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used.
   1. Seal porous glazing channels and recesses with primer or sealer compatible with substrate.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
   1. All glazing exposed to exterior shall be wet/wet or wet/dry in accordance with GANA Glazing Manual for window type.

B. Watertight and airtight installation of each piece of glass is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, impact loading (for operating sash and doors) without failure, including loss or breakage of glass, failure of sealants or gaskets to remain watertight and air tight, deterioration of glazing materials, and other defects in the Work.

C. Adjust glazing channel dimensions as required by project conditions during installation to provide:
   1. Necessary bite on glass.
   2. Minimum edge and face clearances.
   3. Adequate sealant thicknesses, with reasonable tolerances.

D. The glazier is responsible for correct glass size for each opening within the tolerances and necessary dimensions established.

E. Protect glass from edge damage at all times during handling, installation, and operation of the building. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
   1. Inspect each piece of glass immediately before installation and eliminate those that have observable edge damage or face imperfections.

F. Apply primers or sealers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant substrate testing and as recommended by sealant manufacturer.

G. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

H. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

I. Provide spacers inside and out and of proper size and spacing for glass lites where length plus width is larger than 50 united inches, except where gaskets are used for glazing.
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width.
      a. Exception for Glazing Tape: Use thickness slightly less than final compressed thickness of tape.

J. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
   1. Coordinate glazing with wood door stops so stop is flush with outside of face veneer.

K. Voids and Filler Rods: Prevent exudation of sealant or compound by forming voids or installing filler rods in the channel at the heel of jambs and head (do not leave voids in the sill channels) except as otherwise indicated, depending on light size, thickness and type of glass, and complying with manufacturer's recommendations.

L. Do not attempt to cut, seam, nip, or abrade glass that is tempered, heat-strengthened, or coated.

M. Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

N. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

O. Set glass lites with proper orientation so that coatings face protected of exterior or interior as specified.

P. Tool exposed surfaces of glazing liquids and compounds to provide a substantial "wash" away from the glass. Install pressurized tapes and gaskets to protrude slightly out of the channel, so as to eliminate dirt and moisture pockets.

Q. Clean and trim excess glazing materials from the glass and stops or frames promptly after installation and eliminate stains and discoloration.

R. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on the opposite side, provide adequate anchorage to ensure that gasket does not "walk" out when subjected to dynamic movement.

S. Square-cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away. Seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tape to heads and sills first and then to jambs. Cover horizontal framing joints by applying tape to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joint miter cut and bonded together at corners.

C. Installation with Drive-In Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer’s written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.8 CURING

A. Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength, and surface durability.

3.9 PROTECTION, AND CLEANING

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect exterior glass from breakage and other damage immediately upon installation by attaching crossed streamers to framing held away from glass. Do not apply markers to surfaces of glass. Remove non-permanent labels and clean surfaces.

C. Protect glass from contact with contaminating substances resulting from construction operations. If despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
   1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

D. Examine glass surfaces adjacent to or below exterior concrete and masonry surfaces at frequent intervals during construction – but not less than once a month – for buildup of dirt, scum, alkaline deposits, or stains. Remove as recommended in writing by glass manufacturer.

E. Remove and replace glass that is broken, chipped, cracked, or abraded, or that is otherwise damaged due to natural causes, accidents, or vandalism, during the construction period.

F. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass according to:
   1. Written recommendations of glass manufacturer.

G. Do not use scrapers or other metal tools to clean glass.

END OF SECTION 08 80 00

SECTION 08 13 16.13 - ALUMINUM DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Aluminum doors.
   1. Hardware for aluminum doors will be furnished under Division 08 Section “Door Hardware”, except continuous hinges and door bottom sweeps, but installed under this Section.

B. Related Sections:
   1. Division 07 Section “Joint Sealants”: For sealant between aluminum frames and adjacent materials.
   2. Division 08 Section “Aluminum-Framed Storefront.”
   3. Division 08 Section “Door Hardware” for coordination and testing and inspection.
   4. Division 08 Section “Glazing”: For glazing of doors and windows.

1.2 DEFINITIONS

A. Definitions: For fenestration industry standard terminology and definition refer to American Architectural Manufacturers Association (AAMA) – AAMA Glossary (AAMA-AG).

1.3 PRE-INSTALLATION MEETING:

A. Pre-installation Meeting: Conduct meeting at project site in conjunction with door hardware meeting.
   1. Agenda
      a. Review and finalize construction schedule.
      b. Review code and project performance compliance documentation and testing requirements including product certification for energy (U-value, SHGC), ADA, etc.
      c. Review means and methods related to installation, including manufacturer’s written instructions.
      d. Examine support conditions for compliance with requirements including alignment and attachment to structural members.
      e. Review flashings, openings, and conditions of other construction affecting this work.
      f. Review temporary protection requirements for during and after installation of this work.

1.4 ACTION SUBMITTALS

A. Product Data: For each product specified.
   1. Include details of construction relative to materials, dimensions of individual components, profiles, finishes, anchorage and fasteners, glazing, and internal drainage.
   2. Operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: Show elevations of each door type, door construction details and methods of assembling sections, hardware locations and installation methods, dimensions, and shapes of materials, anchorage and fastening methods, weatherstripping, and finish requirements.
   1. Provide schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings and Schedules.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product Test Reports: For verification of “Performance Requirements”.

B. Energy Performance Certificates: Energy Performance Certificates: Signed and dated certification for the installed doors listing the U-factor and air leakage rate.
   1. Basis for Certification: NFRC-certified energy performance values for each aluminum door type.

1.6 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Operation and Maintenance Data: For aluminum-framed systems to include in maintenance manuals. Include maintenance procedures for care and cleaning of entrance systems, as well as maintenance tools specific to door maintenance.
   2. Warranties: Special warranties specified in this Section.

1.7 MAINTENANCE

A. Entrance Door Hardware: Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer and supervisor who has specialized in installing aluminum doors similar to those required for this Project and who is acceptable to manufacturer.
   1. Perform work in accordance with AAMA SFM-1 and manufacturer's written instructions.

B. Regulatory Requirements: Doors shall be provided to conform to the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local Regulations. Where openings, in the opinion of the supplier/manufacturer, do not conform, the A/E shall be notified.
   1. Conform to requirements of ANSI A117.1 and local amendments.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Materials to be packed, loaded, shipped, unloaded, stored and protected in accordance with AAMA C101-10.

B. Do not used adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

C. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
   1. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of this Work to be performed according to manufacturer's installation instructions and warranty requirements.
   1. Install sealant according to sealant manufacturer guidelines.

B. Field Measurements: Check openings by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the work.

1.11 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Water leakage through fixed glazing and framing areas.
   2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
   1. Warranty covers factory-applied finishes on exposed extruded aluminum surfaces without standing water accumulation, against peeling, checking, cracking, checking and change of color, per applicable AAMA specifications.
   2. Anodized Coatings
      a. AAMA 611 Class I: 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Products: Subject to compliance with requirements, provide one of the products specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
      a. Tubelite Inc. (Tubelite) a subsidiary of Apogee Framing Systems
      b. EFCO Corporation (EFCO) a subsidiary of Apogee Framing Systems
      c. Kawneer Company, Inc. (Kawneer)
      d. U.S. Aluminum Division, CR Laurence Co. (CRL).
      e. YKK AP America Inc. (YKK)
      f. Oldcastle Building Envelope

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Refer to Division 08 Section "Aluminum-Framed Storefront" for additional "opening" requirements.

B. General: Provide aluminum doors capable of withstanding loads and thermal and structural movement requirements without failure, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg. F, material surfaces.

C. Design Wind Loads
   1. Wind Loads: As indicated on Drawings.

D. Structural: Test according to ASTM E330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites of glass to 3/4 inch whichever is smaller.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceed 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Performance Requirements: Exterior entrance doors
1. Air Infiltration Test: With door sash closed and locked, test units in accordance with ASTM E283 or NFRC 400 at a static air pressure difference of 1.57 psf.
   a. Air infiltration shall not exceed .50 cfm/SF of unit, for single doors.
   b. Air infiltration shall not exceed 1.0 cfm/SF of unit, for a pair of doors.
2. Water Penetration under Static Pressure: Test according to ASTM E331 and as follows:
   a. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq.ft.

F. Energy Performance: Certify and label energy performance according to NRFC as follows:
1. Thermal Transmittance (U-factor): Thermally-improved doors shall have U-factor at not more than the following:
   a. Entrance Doors: 0.63 Btu/sq.ft. x h x deg F.
   b. Operable (main entrance door): 0.45 Btu/sq.ft. x h x deg F.
2. Labeling of Doors: The U-factor and the air leakage rate for all manufactured doors installed between conditioned space, semi-heated space, unconditioned space, and exterior space shall be identified on a permanent nameplate installed on the product by the manufacturer.
   a. When doors do not have such a nameplate, the installer or supplier of any doors shall provide a signed and dated certification for the installed doors listing the U-factor and air leakage rate.

2.3 STANDARD DOORS (VESTIBULE DOOR)

A. Stile and Rail Design: Wide stile, nominally 5–inch wide vertical stiles, 6-1/2–inch high top rail, intermediate rail, and nominally 10–inch high bottom rail.
1. Series 550 (modified top and bottom rail and door muntin): U.S. Aluminum Division of CRL.
2. Series D500 (modified top and bottom rail) and mid-rail: EFCO.
3. 500 (modified top and bottom rail) and intermediate rail: Kawneer.
4. Wide Stile (modified top and bottom rail and intermediate rail): Tubelite.
5. 50D Wide Stile (modified top and bottom rail and intermediate rail): YKK.
6. WS-500 Wide Stile: Oldcastle Building Envelope.

2.4 THERMALLY IMPROVED DOORS (MAIN ENTRANCE DOOR)

A. Wide Style Door: Designed to meet security, egress, thermal performance and dual finish capability as required.
1. Thermastile (D502); EFCO
2. 500T Insulpour; Kawneer
3. Therml=Block; Tubeline
4. MegaTherm 50XT; YKK
5. Series 550-T; U.S. Aluminum Division of CRL
6. Series 750-T High Performance Thermal Door; U.S. Aluminum Div. of CRL.
7. Promar Series 500 Door; Oldcastle Building Envelope.

B. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the exterior or thermally isolated with a polyurethane polymer thermal break.

2.5 DOOR MATERIALS AND CONSTRUCTION

A. Sections shall be extruded from 6063-T5 aluminum alloy (ASTM B221 Alloy GS 10A T5).

B. Major portions of the door stiles shall be 0.125 inch in thickness, and glazing molding shall be 0.050 inch thick.
   1. Mullions shall be as detailed on Drawings and as required for type of door being furnished.
   2. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.
   3. Glazing Stops and Gaskets: Square, snap-on, extruded aluminum stops and preformed gaskets of neoprene bulb type.
      a. Provide lock-in tamperproof type glazing stops on outside of door.
      b. No exposed screws shall be required to secure stops.

C. Screws, miscellaneous fastening devices, and internal components shall be of stainless steel, plated, or corrosion-resistant materials of sufficient strength to perform the functions for which they are used.

D. Wide Stile: Corner construction shall consist of both sigma deep penetration and sigma fillet welds and mechanical fastening. Inside joints between the top rail and vertical stiles shall have a continuous bead of sealant. Interior glazing stops shall be square snap-in type with neoprene bulb type glazing. Square stops on exterior side shall be lock-in tamperproof type. No exposed screws shall be required to secure stops.

E. Weathering: Manufacturer's replaceable components used as tested for air-infiltration, water penetration and thermal "Performance Requirements".

F. Where ADA-compliant threshold is scheduled, provide door with door bottom sweeps and undercut door as required for weathertight seal. Verify type threshold with door hardware schedule.

G. Doors shall have the lockstile portion of the top rail closed for mounting security door contacts.

H. Where aluminum doors are scheduled to receive a concealed overhead stop, the jamb bracket shall be mortised into the frame and the channel mortised into the top of the door. The cut for the arm on the stop side of the door shall not be cut below the stop strip of the frame.

2.6 DOOR AND WINDOW FRAMING MATERIALS AND CONSTRUCTION

A. Refer to Division 08 Section "Aluminum-Framed Storefront".

2.7 HARDWARE

A. Basis-of-Design: Aluminum doors specified in this Section shall receive heavy-duty full-mortise continuous-gear hinges as manufactured by the Roton Division of the Hager Companies. Furnish 780-226HD (for flush-mounted doors) or 780-111HD/780-224HD (for doors inset from frame) as required by frame manufacturer.
   1. Subject to compliance with requirements, provide either the named products or comparable products by one of the following.
      a. Architectural Builders Hardware Mfg., Inc.; A110HD or A111HD/A240HD.
      b. Bommer Inds., Inc.; FM-SLFHD or FM-SLIHD/FM-HD.
      c. McKinney Products Company, Assa Abloy; MCK-12HD or MCK-14HD/MCK-25HD.
      d. Pemko Mfg. Co., Assa Abloy; FM-SLFHD or FM-SLIHD/FM-HD.
      e. Select Products Limited; SL-11HD or SL-18HD/SL-24HD.
      f. Stanley Hardware; 661HD or 662HD.
      g. Zero International; 910DB or 914DB.

B. Continuous gear hinge finish shall match door and frame finish.

1. Where painted finish is required, the hinge cap shall be painted by the door manufacturer with the same high-performance organic coating as the door and frame.

C. For balance of hardware furnished by others, refer to Division 08 Section “Door Hardware”.

2.8 GLAZING

A. Glazing: Comply with Division 08 Sections “Glazing” and “Security Glazing” and as required to meet “Performance Requirements”.
1. Glass shall be as required to meet “Performance Requirements”.

B. Glazing Gaskets: As recommended by manufacturer to meet “Performance Requirements” and general requirements of Division 08 Section “Glazing”.

2.9 FABRICATION

A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to shop drawings.

B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.

C. Entrances: Fabricate door framing in profiles indicated. Reinforce as required to support imposed loads. Factory-assemble door units and factory-install hardware to greatest extent possible. Reinforce door units as required for installing hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.
1. Interior Doors: Provide ANSI/BHMA A156.16 silencers at stops to prevent metal-to-metal contact. Provide 3 silencers on strike jamb of single door frames and 2 silencers on head of double door frame.
2. At pairs of exterior doors, provide sliding-type weatherstripping retained in adjustable strip and mortised into door edge to comply with “Performance Requirements”.
3. At exterior doors, provide weather sweeps applied to door bottoms to comply with “Performance Requirements”.

D. Entrance Door Hardware Installation: Factory install entrance door hardware specified in this Section by the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

E. After fabrication, clearly mark components to identify their location in Project according to Shop Drawings.

2.10 FINISH

A. General: Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations relative to applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within 1/2 of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

D. Color Anodic Finish: AAMA 611-20, AA-M12C22A44 or AA-M10C21A44, Class I, 0.018 mm or thicker.

1. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.
   1. Verify location of preset anchors, perimeter fasteners, and block-outs are in accordance with shop drawings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.
   1. Aluminum Surface Protection: Protect aluminum surfaces from contact with lime, mortar, cement, acids, and other harmful contaminants.

3.3 INSTALLATION

A. Aluminum doors shall be securely installed according to the manufacturer's recommendations, and operating hardware shall be checked for proper function and adjustment. Comply with manufacturer's product data, including product technical bulletins, installation instructions, and product carton instructions.
   1. Adjust weatherstripping contact and hardware movement to produce proper operation.

B. Install entrances plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers written instructions.
   1. Field-Installed Entrance Door Hardware: Install surface mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible.

C. Install glazing to comply with requirements of Division 08 Section "Glazing", unless otherwise indicated.

D. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
   1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weatherstripping.

E. Do not cut aluminum frame stop strip when mounting exit devices and closers.

F. Where aluminum doors are scheduled to receive a concealed overhead stop, the jamb bracket shall be mortised into the frame and the channel mortised into the top of the door. The cut for the arm on the stop side of the door shall not be cut below the stop strip of the frame.

3.4 ERECTION TOLERANCE

A. Refer to Division 08 Section "Aluminum-Framed Storefronts".

3.5 FIELD QUALITY CONTROL

A. Inspections: Refer to Division 08 Section "Door Hardware" for egress door assembly inspections and testing.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Re-inspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.6 ADJUSTING/CLEANING

A. Adjust doors and hardware to provide tight fit at contact points and weatherstripping, smooth operation, and weathertight closure.
   1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

B. Cleaning: Comply with AAMA 609 and 610 for methods, equipment, and materials to clean finished aluminum after installation.

C. Remove excess sealant and glazing compounds, and dirt from surfaces.

3.7 PROTECTION

A. Protect the aluminum doors and their finish against damage from construction activities and harmful substances. Clean the aluminum surfaces as recommended for the type of finish applied.

END OF SECTION 08 13 16

DIVISION 09

FINISHES

ECTION 09 21 16.00 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Gypsum board, metal support systems, metal accessories, fasteners, and related items necessary as indicated and as follows:
   1. Interior gypsum board products types, sizes, and thickness indicated.
      a. Gypsum boards shall have fire-resistance ratings and be moisture and mold resistant.
         1) Joint treatment shall be moisture and mold resistant.
   2. Tile backing boards shall be glass-mat, water-resistant backing board, unless otherwise indicated.
      a. Tile backing boards, located in “wet” walls shall be cementitious backer board.
   3. Non-Structural Steel Framing, including firestop top track seals.
      a. Interior framing systems (e.g., supports for partition walls, framed soffits, etc.).
      b. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).
   4. Acoustical insulation unless specifically excluded.
   5. Reinforcement, both metal and wood, within framing systems to support wall and ceiling-mounted furnishings or equipment provided by other trades.

B. Related Sections include the following:
   1. Division 01 Section “Alternates” for descriptions of alternates affecting the Work of this Section.
   2. Division 05 Section “Cold-Formed Metal Framing”: For exterior non-load-bearing wall studs and where indicated.
   3. Division 06 Section “Miscellaneous Rough Carpentry”: For wood blocking.
   4. Division 06 Section “Sheathing”: For gypsum sheathing (exterior).
   5. Division 07 Section “Thermal Insulation”: For thermal insulation and vapor barriers.
   6. Division 07 Section “Penetration Firestopping”: For firestopping systems.
   7. Division 07 Section “Acoustical Joint Sealants” for acoustical sealants.
   8. Division 09 Section “Interior Painting”: For primers applied to gypsum board surfaces and for coordination of repair work.

1.2 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C11 for definitions of terms related to gypsum board assemblies not defined in this Section or in other referenced standards.

B. Wet Walls: Walls with plumbing fixtures mounted on them and walls in shower or similar areas that will be intermittent wet.

C. Abuse-Resistance: ASTM C1629

		Performance Types			
	Description	Abrasion (ASTM D4977)	Indentation (ASTM D5420)	Hard-Body Impact (Annex A1)	Soft-Body Impact (ASTM E695)
1 (ARGB)	A basic upgrade to standard drywall. Provides improved resistance to incidental surface and impact damage.	0.126 inch	0.150 in.	50 ft-lbs.	90 ft-lbs.
2 (IRGB)	Provides moderate resistance to incidental surface and impact damage from people and objects.	0.059 inch	0.100 in.	100 ft-lbs.	195 ft.-lbs.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination
   1. Coordinate blocking and furring work with installers of related work including, but not limited casework, acoustical ceilings, thermal insulation, gypsum board, light fixtures, mechanical system, electrical systems, and sprinklers.
   2. All work above ceiling line should be completed, prior to installing the gypsum board. There should be no materials resting against or wrapped around the suspension system, hanger wires or ties.

B. Pre-Installation Meeting: Conduct a pre-installation meeting to verify project requirements, substrate conditions, and manufacturer's installation instruction.
   1. Review blocking requirements.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's product data and installation instructions for each type of product indicated, including other data as might be required to show compliance with these Specifications, including firestop top track seal manufacturer's printed installation instructions.
   1. Submit data indicating compliance with "fire-test-response characteristics".

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Gypsum Board, Certification: Letter from manufacturer certifying materials contain less than 1 percent asbestos by polarized light microscopy (PLM) analysis.

1.6 QUALITY ASSURANCE

A. Materials or operations specified by reference to the published specifications of a manufacturer or other published standards shall comply with the requirements of the standards listed.
   1. Standards include ASTM C840 and GA216, except more stringent requirements of manufacturer shall govern.
   2. Materials brought on-site shall contain less than 1 percent asbestos by polarized light microscopy (PLM) analysis.
   3. Applicable requirements of ASTM C754 for installation of steel framing.
   4. Apply acoustical sealant in accordance with applicable requirements of ASTM C919.

B. Refer to "Recommended Specification on Levels of Gypsum Board Finish" as published by the Gypsum Association (and AWCI/CISCA/PDCA) for finish levels required herein.

C. Mold-Resistant: Gypsum board assemblies designed to provide extra protection against mold and mildew compared to standard paper-faced wallboard products. When tested by an independent lab per ASTM D3273 ("Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber") gypsum board shall achieve an average board score of 8 or greater out of a possible high score of 10.

D. Gypsum Board Finish Mockups: Before finishing gypsum board assemblies, install mockups of at least 100 sq.ft. in surface area to demonstrate aesthetic effects and qualities of materials and execution.
   1. Install mockups for the following applications:
      a. Level 5 finish.
   2. Simulate finished lighting conditions for review of mockups.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected from weather, condensation, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum boards flat to prevent sagging.
   1. Protect joint compounds from freezing.

C. Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

D. Protect metal framing from corrosion, deformation and other damage during delivery, storage, and handling per requirements of AISI's S202, "Code of Standard Practice" for Cold-Formed Steel Structural Framing".

E. Waste Management: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or coordinate landscape work for gypsum soil amendment. Do not use products containing glass fiber for soil amendment.
   2. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.
   3. Fold up metal banding, flatten, and place in designated area for recycling.
   4. Select board sizes and layout boards to minimize mastic; reuse cutoffs to the greatest extent possible.

1.8 FIELD CONDITIONS

A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C840 and with gypsum board manufacturer's recommendations. Do not install gypsum board when ambient temperature is below 40 deg. F.
   1. Do not install paper-faced gypsum boards until installation areas are enclosed and conditioned.
      a. Only interior extended exposure gypsum boards maybe installed.
   2. Maintain dry bulb temperatures between 55 and 80 degrees F. and relative humidity at less than 50 percent during taping and curing of joint compound.

B. Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 degrees F. For adhesive attachment and finishing of gypsum board, maintain not less than 55 degrees F. for 48 hours prior to application and continuously after until dry. Do not exceed 80 degrees F. when using temporary heat sources.

C. Ventilation: Ventilate building spaces, as required, for dry joint-treatment materials. Avoid drafts during hot dry weather to prevent finishing materials from drying too rapidly.

D. Do not install boards that are wet, those that are moisture-damaged, and those that are mold-damaged.
   1. Indications that boards are wet or moisture-damaged include, but are not limited to discoloration, sagging, or irregular shape.
   2. Indications that boards are mold-damaged include, but are not limited to fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Abuse-Resistant/Mold-Resistant Gypsum Boards (Level 1-Abuse Resistance) (ARGB)
      a. Sheetrock Mold Tough AR; United States Gypsum Company
      b. Hi-Abuse XP Wallboard; National Gypsum Co.
      c. Extreme Abuse-Resistant with M2Tech; CertainTeed Gypsum, Inc.
      d. M-Bloc Impact Resistant; American Gypsum
      e. Den Armour Plus (Impact-Resistant); Georgia Pacific
   2. Impact-ResistantMold-Resistant Gypsum Boards (Level 2-Impact Resistance) (IRGB)
      a. Mold Tough VHI; United States Gypsum Company
      b. Hi-Impact XP Wallboard; National Gypsum Company
      c. Extreme Impact-Resistant with M2Tech; CertainTeed Gypsum, Inc.
      d. Protecta HIR 300 with Mold Defense; Continental Building Products, LLC (fka Lafarge)
      e. Dens Armour Plus (Impact-Resistant); Georgia Pacific
   3. Glass-Mat-Mold and Moisture Resistant (Interior Extended Exposure Gypsum Boards)
      a. eXP® Interior Extreme; National Gypsum Co.
      b. Weather Defense Platinum Interior; Continental Building Products, LLC (fka Lafarge).
      c. Sheetrock Brand Glass-Mat Mold Tough Firecode X; United States Gypsum Company.
      d. DensArmor Plus High Performance Interior Boards, Georgia Pacific.
   4. Moisture and Mold Resistant Gypsum Boards (WGWB)
      a. EcoSmart Mold Tough (Firecode); United States Gypsum Company.
      b. XP Fireshield Wallboard; National Gypsum Co.
      c. M2Tech Gypsum Wallboard or Air Renew (Type X); CertainTeed Gypsum, Inc.
      d. M-Bloc (Type X) ; American Gypsum
      e. Mold-Guard Gypsum Board, ToughRock Mold-Guard, or Dens Armour Plus (Interior) (Type X); Georgia Pacific
      f. Mold Defense (Type X); Continental Building Products, LLC (fka Lafarge)
   5. Glass-Mat, Water-Resistant Tile Backing Board (GWTB)
      a. GlasRoc Tile Backer Type X; CertainTeed Corp.
      b. Gold Bond eXP Tile Backer; National Gypsum Company
      c. Durock Brand Glass-Mat Tile Backerboard; USG Corporation
      d. DensShield Tile Backer; Georgia-Pacific Gypsum LLC
   6. Cementitious Tile Backer Units (CTBU)
      a. Wonderboard; Custom Building Products
      b. Util-A-Crete Concrete Backer Board; Fin Pan, Inc.
      c. Durock Cement Board; USG Corp.
      d. Perma Base Cement Board; National Gypsum Co.
      e. Hardiebacker 500; James Hardie Building Products, Inc.
      f. C-Cure Board 900; C-Cure.
      g. CertainTeed LLC; Saint-Gobain North America.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other board products or from a manufacturer acceptable to the gypsum board manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. System Requirements: Fabricate and install systems as indicated, but not less than that required to comply with ASTM C754 under the following conditions:
   1. Gypsum board partitions:
      a. Standard systems: Maximum deflection of L/240 of partition height.
      b. Systems to receive tile: Maximum deflection of L/360 of partition height.
   2. Interior Suspended Soffits: Maximum deflection of L/360 of distance between supports.
   3. Design framing system to accommodate deflection of primary building structure and construction tolerances and to withstand design loads with a maximum deflection of 1 inch, unless otherwise noted.
   4. Design framing systems in accordance with AISI S220, unless otherwise indicated.

B. Low-Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with AISI S220 for conditions indicated.
   1. Steel Sheet Components: Comply with AISI S220 requirements for metal, unless otherwise indicated.
   2. Protective Coating: AISI S220 and ASTM A653, G40 (Z120), or coating with equivalent corrosion resistance, unless otherwise indicated.
      a. Coatings shall demonstrate equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
      b. Provide a protective coating, ASTM A653, CP60, hot-dip metallic coating at wet walls and where indicated.
      c. Galvannealed products are not acceptable.

2.4 STEEL FRAMING FOR PARTITIONS AND SOFFITS

A. Steel Studs and Runners: AISI S220 with flange edges of studs bent back 90 degrees and doubled over to form 3/16 inch wide minimum lip (return), and complying with the following requirements:
   1. Thickness and spacing of studs shall be as indicated, but not less than that required complying with AISI S220 with maximum deflection L/240 at 5 lbf. per sq.ft., unless otherwise noted.
      a. Tile finishes applied to cementitious backer units maximum deflection shall be L/360.
   2. Unless indicated otherwise, metal stud framing shall be formed from 0.0296-inch minimum sheet base metal (fka 20 gauge-non-structural) or equivalent thickness 0.0181 inch (fka 20EQ gauge non-structural).
      a. Framing shall not exceed an unbraced length of 16’-0” when framing is 16 inches on center.
   3. Depth: As indicated.

B. Slip-Type Head Joints: Provide one of the following:
   1. Single Long-Leg Runner System: AISI S220 top runner with 2 inch deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs of provide lateral bracing.
   2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) The Steel Network, Inc.; VertiClip SLD Series or VertiTrack VTD Series.

2) ClarkDietrich; MaxTrak or Slotted Deflection Track.
3) Metal-Lite, Inc.; Slotted Track.
4) MarinoWARE STL Slotted Track.

C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing.
1. Flat Strap: Minimum Base Steel Thickness: 0.0296 inch (fka 20 gauge).
2. Backing Plate: Steel galvanized, 6 inches wide by 0.0538 inch (fka 16 gauge) thick minimum by lengths to suit size of items to be attached; fastened to studs for attachment of surface mounted fittings and accessories.
a. Provide either backing plates or wood blocking. Direct attachment of accessories or equipment to studs is strongly discouraged, unless loads have been analyzed.
1) Contractor's Option: For wood blocking contractor may use Clark Dietrich; Danback Fire-Retardant Treated Wood Backing Plate or comparable products by a current member of SFIA or SSMA.

D. Cold-Rolled Channel Bridging: 0.0538-inch base steel thickness (fka 16 gauge), with minimum 1/2-inch-wide flange.
1. Depth: 1-1/2 inches, unless otherwise noted.
2. Clip Angle: 1-1/2 by 1-1/2 inch, 0.053 inch thick (fka 16 gauge), galvanized steel.
3. Proprietary bridging may also be provided as contractor's option.

E. Hat-Shaped, Rigid Furring Channels: AISI S220.
1. Minimum Base Steel Thickness 0.0179 inch (fka 25 gauge).
2. Depth: 7/8 inch, unless otherwise noted.

F. Soffit Framing System (Option): Prefabricated soffit framing system that clicks into shape and installs quickly.
1. Aligns with construction industry dynamics:
a. Enhanced safety.
b. Reduced need for skilled labor.
c. Transition from stick-build to pre-fab/off-site construction.
2. Minimum G40 hot-dipped, galvanized coating (per ASTM C645); provides superior corrosion resistance.
3. Basis-of-Design: SIMPLESOFFIT; Armstrong Ceiling and Wall Solutions.

2.5 GYPSUM BOARD PRODUCTS

A. General Requirements: Comply with ASTM C 1396. Provide in maximum lengths and widths available that will minimize joints in each area, that will minimize joints in each area, and that correspond with support system indicated.
1. Unless otherwise noted all gypsum board shall be fire-resistance-rated. Refer to Code Plan in Construction Drawings for specific locations and requirements of fire-resistance-rated assemblies indicated.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
3. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
4. Where building is not enclosed and environmental conditions cannot be maintained only interior extended exposure gypsum boards maybe used. Only setting type joint compounds may be used as well.
5. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

B. LEED Performance Requirements
1. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers".

C. Abuse-Resistant/Mold-Resistant Gypsum Boards (Level 1) (ARGB): Boards shall be 5/8 inch thick, complying with Type X or C fire resistance in accordance with ASTM C1396, and C1629, and for NFPA Class 1 Flame Spread, Smoke Development and Fuel Contribution under ASTM E84.
   1. Surface Abrasion: ASTM C 1629, meets or exceeds Level 2 requirements.
   2. Indentation: ASTM C 1629, meets or exceeds Level 1 requirements.
   3. Soft-Body Impact: ASTM C 1629, meets or exceeds Level 1 requirements.

D. Impact-Resistant/Mold-Resistant Gypsum Boards (Level 2) (IRGB): Boards shall be 5/8 inch thick, complying with Type X fire-resistance in accordance with ASTM C1396 and C1629, and for NFPA Class I Flame Spread, Smoke Development and Fuel Contribution under ASTM E84.
   1. Surface Abrasion: ASTM C 1629, meets or exceeds Level 2 requirements.
   2. Indentation: ASTM C 1629, meets or exceeds Level 1 requirements.
   3. Soft-Body Impact: ASTM C 1629, meets or exceeds Level 3 requirements.
   4. Hard-Body Impact: ASTM C 1629, meets or exceeds Level 2 requirements.

E. Glass-Mat Interior Gypsum Board (Interior Extended Exposure) (EGWB): ASTM C 1658 with fiberglass mat laminated to both sides. Specifically designed for interior use.
   1. Core: 5/8 inch Type X or abuse resistant as indicated.
   2. Long Edges: Tapered.

F. Moisture-and Mold-Resistant Gypsum Boards (WGWB): ASTM C 1396 with moisture and mold resistant core and surfaces.
   1. Core: 5/8 inch, Type X.
   2. Long Edges: Tapered.
   3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

G. Flexible Gypsum Wallboard (FGWB): ASTM C 1396, manufactured to bend to fit tight radii and to be more flexible than standard regular-type boards of the same thickness.
   1. Thickness: 1/4 inch.
   2. Long Edges: Tapered.
   3. Location: Where bending radii is less than 15 feet.
      a. Apply in double layer at curved assemblies.

2.6 TILE BACKING BOARDS

A. Glass-Mat, Water-Resistant Backing Board (GWTB): Comply with ASTM C1178 or C1177.
   1. Core: 5/8 inch, Type X or C, unless otherwise noted.
   2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

B. Cementitious Backer Board (CTBU): Complying with ANSI A118.9 and ASTM C1288 or 1325 of thickness indicated and in maximum lengths available to minimize end-to-end butt joints. Ends and edges shall be square cut and finished smooth; formed in a continuous process of aggregated Portland-cement slurry; and reinforced with vinyl coated, woven glass-fiber mesh embedded in both surfaces.
   1. Thickness: Manufacturer's standard thickness, but not less than 7/16 inch, unless otherwise indicated.
   2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

C. Water-Resistant Gypsum Backing Board per ASTM C1396 is not an acceptable substitute for any of the products hereinbefore specified.

2.7 ACOUSTICAL INSULATION MATERIALS

A. Sound-Attenuation Blankets: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without facing membrane), unless noted otherwise.
   1. Mineral-Fiber Type: Fibers manufactured from glass, slag wool, or rock wool.

a. Where used in fire-resistance rated assemblies, mineral fiber types shall correspond with requirements of tested assemblies.
b. Low Emitting: Insulation shall be tested according to ASTM D 5116, EPA compendium methods, or ISO methods and shown to have a formaldehyde emittance of less than 16.3-ppb formaldehyde. Laboratories that conduct the tests for chemical analysis of formaldehyde and voltaic organic compounds must be accredited under ISO/IEC 1705 for the test method they use. Total volatile organic compounds must have a maximum concentration of 500 micrograms per cubic meter.

B. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Products: Subject to compliance with requirements, provide one of the following:
a. BOSS 826 Acoustical Sound Sealant; Accumetric LLC.
b. RCS 20 Acoustical; GE Construction Sealants.
c. Acoustical Sealant GSC; Grabber Construction Products.
d. OSI Pro-Series SC-175 Acoustical Sound Sealant; Henkel Corp.
e. AC-20 FTR or AIS-919; Pecora Corp.
f. Smoke-N-Sound Acoustical Sealant; Specified Technologies, Inc.
g. Quiet Seal Pro; Serious Energy, Inc.
h. SHEETROCK Acoustical Sealant; USG Corp.
i. CP 506 Smoke and Acoustical Sealant; Hilti.
j. Titebond GREENchoice Professional Acoustical Smoke and Sound Sealant: Franklin International.
2. Acoustical joint sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

2.8 MISCELLANEOUS MATERIALS

A. General: Comply with ASTM C475 and C1396. Provide auxiliary materials that comply with referenced installation standards.

B. Joint Tape: Tape shall be mold resistant and achieve a 10 rating when tested per ASTM D 3273.
1. Interior Gypsum Board (Temperature/Humidity controlled): Paper.
2. Glass-Mat Gypsum Sheathing Board (on non-temperature/humidity controlled environment): 10 by 10 glass mesh.
3. Tile Backing Boards (cementitious): As recommended by board manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats. Pre-mixed compounds shall be free of antifreeze, vinyl adhesives, preservatives, biocides, and other slow releasing compound. All-purpose type compound will not be acceptable for prefilling, embedding, first coat, or fill coat.
1. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats. Pre-mixed compounds shall be free of antifreeze, biocides, and other slow releasing compound. All-purpose type compound will not be acceptable for prefilling, embedding and first coat.
2. Prefilling: At open joints and damaged surface areas, use setting-type compound.
a. ProForm Brand Quick Set Lite Setting Joint Compound, by National Gypsum Company.
b. Sheetrock Brand Easy Sand Setting Type Joint Compound, by USG.
c. Comparable product approved by one of the gypsum board manufacturers listed.

3. Level 2: Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type compound.
    a. ProForm Brand Quick Set Lite Setting Joint Compound or ProForm Brand Lite Blue Ready Mix Joint Compound, by National Gypsum Company.
    b. Sheetrock Brand Easy Sand Setting Type Joint Compound or Sheetrock Brand Plus 3 Lightweight or Ultra Lightweight All Purpose Joint Compound, by USG
    c. Comparable product approved by one of the gypsum board manufacturers listed.
4. Level 3: Fill coat, Second and Third Coat: For third coat, use all –purpose, midweight, topping, or lightweight compounds.
    a. ProForm Brand Lite Blue Ready Mix or ProForm All Purpose with Dust-Tech Joint Compound, by National Gypsum Company.
    b. Sheetrock Brand Plus 3 Lightweight or Ultra Lightweight All Purpose Joint Compound, by USG
    c. Comparable product approved by one of the gypsum board manufacturers listed.
5. Level 4: Finish Coat: For fourth coat, use all-purpose, midweight, topping, or lightweight compounds.
    a. ProForm Brand Lite Blue Ready Mix or ProForm All Purpose with Dust-Tech Joint Compound, by National Gypsum Company.
    d. Sheetrock Brand Plus 3 Lightweight or Ultra Lightweight All Purpose Joint Compound, by USG
    e. Comparable product approved by one of the gypsum board manufacturers listed.
6. Level 5: Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound, or a high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
    a. Primer and its application to surfaces are specified in Division 09 Section "Interior Painting."

D. Joint Compound for Cementitious Backer Board: Material recommended by cementitious backer unit manufacturer.

E. Steel Screws for Gypsum Board: ASTM C1002, unless otherwise noted.
1. Use screws complying with ASTM C954 for fastening boards to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by board manufacturer.

F. Fasteners for Metal Framing: Of type, material, size, corrosion-resistance, holding power, and other properties required to fasten steel members to substrates.

G. Accessories for Interior Installation: Corner bead, edge trim, and control joints complying with ASTM C1047 and requirements indicated below:
1. Material: Formed metal with metal complying with the following requirements:
    a. Steel sheet zinc-coated by hot-dip or electrolytic process, or steel sheet coated with aluminum or rolled zinc, unless otherwise noted.
        1) Do not use plastic accessories, unless otherwise noted or approved by A/E in writing.
        2) Provide paper-faced galvanized steel sheet at abuse-resistant gypsum boards, where recommended by manufacturer.
2. Shapes indicated below by reference to Figure 1 designations in ASTM C1047:
    a. Corner Bead: Use at outside corners, unless otherwise indicated.
    b. L-bead with face flange only; face flange formed to receive joint compound. Use for edge trim (perimeter relief).
    c. LC-bead (J-shaped): Exposed long flange receives joint compound; use at exposed board edges.
    d. One-piece control joint formed with V-shaped slot and removable strip covering slot opening.
3. Base-of-Wall Galvanized Moisture Barrier Trim (option): Galvanized-steel sheet, 2 inches high.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:
1) VersaDry, LLC

4. Base-of-Wall PVC Moisture Barrier Trim (option): Extruded PVC 1/2 inch high.
a. Manufacturers: Subject to compliance with requirements, provide products by the following:
1) Waterguard, www.keeps/Drywall/Dry.com.

H. Isolation Strip at Exterior Walls: Provide one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gaskets: Closed-cell vinyl foam adhesive-backed strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit metal stud size indicated.

I. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum boards to continuous substrate.
1. Do not adhere gypsum board directly to CMU on an exterior wall.
2. Laminating adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, and structural framing with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section.

B. Examine boards before installation. Reject boards that are wet, moisture damaged, and mold damaged.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLING STEEL FRAMING, GENERAL

A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation, except comply with framing sizes and spacing indicated.
1. Do not bridge building expansion and control joints with steel framing or furring members. Independently frame both sides.
2. Install bracing at terminations in assemblies.
3. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, (shelving) or similar construction.
a. Install backer plates or wood blocking accurately positioned and firmly secured to metal studs to support transferred loads.

B. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory or Intertek Laboratories.

3.3 INSTALLING FRAMED ASSEMBLIES

A. Framing systems shall be set to the dimensions indicated on the Drawings.
1. Where framing is installed directly against exterior walls, install felt strips or foam gaskets between studs and wall.

2. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
3. Install steel studs and furring in sizes and at spacing indicated with flanges within framing system pointing in same direction, but not greater than spacings required by referenced installation standards for assembly types.
    a. Space framing 16 inches o.c., unless otherwise indicated.
        1) Framing above ceilings, e.g., partition enclosures may be installed 24 inches o.c.
4. Cover both faces of steel stud partition framing with gypsum boards in concealed spaces (above ceilings, etc.), except in chases that are internally braced.
    a. Fit gypsum boards around ducts, pipes, and conduits.
    b. Where partitions intersect members projecting below underside of floor/roof slabs and decks, cut gypsum boards to fit profile formed by members - allow for deflection and sealant.

B. Align base and cap channel runner track accurately to the partition layout. Secure to concrete floor slabs with 1/2-inch concrete stud nails or other suitable fasteners, not over 24 inches o.c.

C. Assembly connections may be welded instead of screwed.

D. Install horizontal bridging not more than 48 inches apart in walls, where gypsum wallboard is not full height on both sides of partition or “composite” construction. Note: bridging is not needed for an interior, non-axial load bearing wall with gypsum board attached to both stud flanges for the entire height of the wall, unless otherwise noted.
1. Wall stud bridging shall be attached in a manner to secure stud spacing at top and to prevent stud rotation.
2. For walls taller than 30’-0”, horizontal lateral bracing is recommended every 10’-0” o.c.
3. For an interior, non-axial load bearing wall with partial height gypsum board, continuous lateral bracing/bridging is requiring at a 5 ft. maximum vertical spacing above the elevation at which the board is terminated.
4. For an interior, non-axial load bearing wall with gypsum board on one side only, bridging is required a 5-ft. maximum vertical spacing.

E. Isolate steel framing a minimum of 1 inch from building structure whenever wall extends to underside of floor or roof structure to prevent transfer of loading imposed by structural movement. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
1. Use deep-leg or deflection track, unless otherwise noted or required for fire-resistance-rated conditions.
2. Install one row of horizontal bridging parallel to and within 8 inches of head track.
3. Do not attach studs to head track.
4. Do not attach top track in a manner that would penetrate top flute of metal roof deck.

F. Install flat strap diagonal bracing at corners and wherever recommended by stud manufacturer.

G. Frame door openings to comply with GA-600, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Install two studs at each jamb, unless otherwise indicated. Attach vertical studs at jambs with screws to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
1. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joints.

H. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

I. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated, to support closures, and to make partitions continuous from floor to underside of solid structure.
   1. Firestop Deflection Track (Contractor's Option): Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
   2. Firestop Top Track Seal: Install to maintain continuity of fire-resistance-rated assembly indicated. Install in accordance with the firestop manufacturer's printed installation instructions.

J. Install reinforcement within framing system including additional studs, bracing members, plates, channels, and angles to support furnishings or equipment furnished by other trades. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with "Gypsum Construction Handbook" published by United States Gypsum Co. These items include, but are not limited to, the following:
   1. Recessed Items: access boards, fire extinguisher cabinets, electrical boxes, openings for ducts and pipes, miscellaneous electrical, mechanical, or structural penetrations.
   2. Surface-Mounted Items: handrails, grab bars, toilet accessories, curtain tracks, drapery hardware, wall-mounted cabinets, corner guards, door stop, and other finish hardware.
   3. Items Anchored to Walls: casework, shelving, furnishings, toilet partitions, plumbing fixtures, and lockers.

K. Do not bridge building expansion joints and control joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.
   1. Provide a maximum 1/2-inch gap at control joints and fill gap with mineral fiber safing.

L. Installation Tolerances: Install each framing member so fastening surface varies not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 APPLYING AND FINISHING BOARDS, GENERAL

A. Gypsum Board Application and Finishing Standards: Install and finish gypsum boards to comply with ASTM C840.

B. Work shall be provided in accordance with the manufacturer's printed instructions and as specified herein. Where fire-rating requirements for systems are indicated on the Drawings or in the schedules, install components in accordance with manufacturer's instructions to comply with indicated fire rating requirements.
   1. Tolerances
      a. Do not exceed 1/8 inch in 8 feet 0 inches variation from plumb or level in exposed lines of surface, except at joints between gypsum board units.
      b. Do not exceed 1/16 inch variation between planes of abutting edges or ends.
      c. Shim as required to comply with specified tolerances.

C. Wallboard joints shall be butted tightly together.
   1. Install ceiling boards in direction, either parallel or perpendicular to framing members, which results in the least number of joints. Install in maximum practical lengths to span with minimum number of end (butt) joints. Stagger end joints of adjoining boards not less than one framing member.
   2. Form control and expansion joints with space between edges of adjoining gypsum boards.
   3. Attachment to Steel Framing: Attach boards so leading edge or end of each board is attached to open (unsupported) edges of stud flanges first.
   4. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide a minimum of 1/4-inch perimeter relief where board abuts different materials, including floors. Trim edges with U-bead edge trim, where edges of gypsum boards are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
      a. In lieu of 1/4 perimeter relief of gypsum wallboard at floors and acoustical sealant, contractor may install Waterguard in accordance with manufacturer's instructions.

5. Install gypsum boards with face-side out. Butt boards together for a light contact at edges and ends with not more than 1/16 inch of open space between boards. Do not force into place.
6. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
7. Cover both faces of steel-stud partition framing with gypsum boards in concealed spaces (above ceilings, etc.) except in chases braced internally or where gypsum board is specifically noted as being installed on only one side of steel-stud partition framing.
    a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq.ft in area.
    b. Fit gypsum boards around ducts, pipes, and conduits.
    c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum boards to fit profile formed by joists and other structural members; allow 1/4 to 3/8 inch wide joints to install sealant.

D. Install sound attenuation blankets before installing gypsum boards unless blankets are readily installed after boards have been installed on one side.

3.5 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
1. Vertical Surfaces
    a. Surfaces from finished floor to 8 feet above finished floor: Provide abuse-impact/mold-resistant gypsum boards (Level 1) (ARGB), unless otherwise noted.
        1) Provide abuse/impact/mold-resistant boards (Level 2) (IRGB) at public spaces including lobbies, corridors, toilet rooms and classrooms, and where indicated.
    b. Surfaces above 8 feet above finished floor: Provide moisture-and mold-resistant gypsum boards (WGWB), unless otherwise noted.
2. Horizontal Surfaces: Provide moisture-and mold-resistant gypsum boards (WGWB), unless otherwise noted.
3. Interior Extended Exposure Gypsum Boards: To allow for installation of gypsum boards prior to fully enclosing the building envelope, install interior extended exposure gypsum boards in lieu other forms of gypsum board in accordance with manufacturer's recommendations.

B. Single-Layer Application:
1. On partitions/walls, apply gypsum boards vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    a. Stagger abutting end joints not less than one framing member in alternate courses of boards.
    b. Use maximum length boards to minimize end joints.
2. Fastening Methods: Apply gypsum boards to supports with steel drill screws.

C. Multilayer Application:
1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Openings cut in gypsum board to fit electrical outlets, plumbing, and piping shall fit snugly and shall be small enough to be covered by plates and escutcheons. Both face and back paper shall be cut for cutouts that are not made by use of a saw.

1. Make necessary cut-outs and seal cut or exposed board edges as recommended by gypsum board manufacturer.

E. Fasteners: Install fasteners no closer than 3/8 inch to end or edge. Space fasteners approximately 7 inches o.c., opposite each other on adjacent ends or edges. Begin fastening from center of wallboard and proceed toward outer end or edges.

F. Apply pressure on gypsum board, adjacent to fasteners being driven, to insure that gypsum board will be secured tightly to framing member. Check for looseness at fasteners. Drive fastener with shank reasonably perpendicular to face of board.

G. Drive screws with power screwdriver as recommended by gypsum board manufacturer. Surface of head shall be below surface of paper without cutting paper.

H. Direct Bonding (laminating) to Substrate: Where gypsum boards are indicated as directly adhered to a substrate, comply with gypsum board manufacturer's recommendations, and temporarily brace or fasten gypsum boards until fastening adhesive has set.

3.6 APPLYING TILE BACKING BOARDS

A. General
1. Complete plumbing rough-in before gypsum board boards are erected.
2. Separate gypsum boards from rough-in and fixtures by 1/4 inch space.
3. Make necessary cut-outs and seal cut or exposed board edges with thinned-down ceramic tile adhesive or with waterproof flexible sealant, as recommended by gypsum board manufacturer.
4. Prior to tile application, fill openings around pipes, fittings, fixtures, interior angles and other penetrations with silicone sealant, as recommended by gypsum board manufacturer. Do not fill 1/4 inch gap at bottom of boards.

B. Wall Tile Substrates: For substrates indicated to receive thin-set ceramic tile and similar rigid applied wall finishes, comply with the following:
1. Install glass-mat, water-resistant backing board boards to comply with board manufacturer's installation instructions, unless otherwise noted.
2. Install cementitious backer units at showers, tubs, and at "wet" walls to comply with ANSI A108.11. Refer to Division 09 Section "Tile".
3. Where tile backing boards abut other types of boards in same plane, shim surfaces to produce a uniform plane across board surfaces.

3.7 INSTALLING TRIM ACCESSORIES

A. General: For trim with backflanges intended for fasteners, attach to framing with same fasteners used for boards. Otherwise, attach trim according to manufacturer's written instructions.

B. Joint and corner treatment shall be in accordance with the manufacturer's printed instructions to provide a finished surface, ready for painting. Surface shall be free of dimples, excess finishing compound, ridges, or untrue corners.
1. Install edge trim where edge of gypsum boards would otherwise be exposed or semi-exposed. Provide edge trim type with face flange formed to receive joint compound except where other types are indicated.

C. Provide control joints in gypsum board partitions, bulkheads, ceilings, and soffits according to ASTM C840 and as follows:
1. Partition abuts a structural element (except floor) or dissimilar wall or ceiling.
2. Soffit abuts a structural element, dissimilar wall or partition or other vertical penetration.
3. Construction changes within plane of partition or ceiling.
4. Partition run exceeds 30 feet, unless noted otherwise.
5. Ceiling dimensions exceed 40 feet in either direction.

6. Wings of “L”, “U”, and “T”-shaped ceiling areas are joined.
7. Expansion or control joints occur in the exterior wall.
8. Less-than-ceiling-height frames should have control joints extending to the ceiling from both corners. Ceiling height door frames may be used as control joints. Treat window openings in same manner as doors.
9. Control Joint: Apply over face of gypsum board where specified. Cut to length with a fine-toothed hacksaw (32 teeth per inch). Cut end joints square, butt together, and align to provide neat fit. Attach control joint to gypsum board with fasteners spaced 6 inches o.c. maximum along each flange. Remove plastic tape after finishing with joint compound or veneer finish.
    a. Leave a 1/2-inch continuous opening between gypsum boards for insertion of surface-mounted joint.
    b. Do not attach gypsum board to steel studs on one side of control joint.
    c. Provide separate supports for each control joint flange.
    d. Provide an adequate seal behind control joint where sound or fire ratings are prime considerations.

3.8 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
1. Prefill open joints and damaged surface areas.
2. Apply joint tape over gypsum-board joints, except those with trim having flanges not intended for tape.
3. Joint tape and setting compounds shall not reduce moisture and mold resistance of gypsum wallboard assembly.
4. Coats of non-setting type components shall be thoroughly dry before sanding of the application of additional coats.

B. Levels of Finish: The following levels of finish are established as a guide for specific final finishes in accordance with GA-214 and ASTM C840, for locations as indicated.
1. Level 0: No taping, finishing, or accessories required.
    a. This level of finish shall be used in temporary construction only.
2. Level 1: Joints and interior angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
    a. This finish level shall be used in plenum areas above ceilings, in attics, and in areas where the assembly is concealed.
    b. Where a fire-resistance rating is required for the gypsum board assembly, details of construction shall be in accordance with reports of fire tests of assemblies that have met the fire-rating requirement. Tape and fastener heads need not be covered with joint compound.
3. Level 2: All joints and interior angles shall have tape embedded in joint compound and wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Fastener heads and accessories shall be covered with a coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. Joint compound applied over the body of the tape at the time of tape embedment shall be considered a separate coat of joint compound and shall satisfy the conditions of this level.
    a. This level may be used as a substrate for tile.
4. Level 3: Not Used.
5. Level 4: All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Two separate coats of joint compound shall be applied over all flat joints and one separate coat of joint compound shall be applied over interior angles. Fastener head and accessories shall be covered with three separate coats of joint compound. All joint compound shall be smooth and free of tool marks and ridges.
    a. This level is to be used at areas to receive flat paints.

6. Level 5: All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Two separate coats of joint compound shall be applied over all flat joints and one separate coat of joint compound shall be applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. A thin skim coat of joint compound trowel applied, or a material manufactured especially for this purpose and applied in accordance with manufacturer's recommendations, applied to the entire surface. The surface shall be smooth and free of tool marks and ridges.
    a. This level is to be used at areas to receive eggshell and semi-gloss and gloss paint and areas subject to severe lighting, where indicated.

C. Glass-Mat Faced Boards: Finish according to manufacturer's written instructions.

D. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.9 REPAIR

A. General: Finishing of gypsum wallboard assemblies often requires patches and repairs of existing walls or corrections to errors made in erecting new work.
1. Coordinate patching and repair work with work of Division 09 Section “Interior Painting”.
2. Repair and patch as recommended by gypsum wallboard manufacturer.
    a. Small holes use a patching or setting compound as recommended by manufacturer.
    b. For larger holes up to 12 inches reinforce patch with fiberglass tape.
    c. For even larger opening gypsum repair clips may be incorporated.
3. Where ceilings and walls are badly disfigured, a fresh surface maybe desirable. The wall can be resurfaced with a layer of 1/4 inch or 3/8 inch gypsum boards.
    a. Preparation: Remove all loose surfacing material and trim if necessary to create a smooth surface. Fill small holes with joint compound or patching compound. Patch large holes to the surrounding level with single or multiple layers of gypsum board attached to framing and shimmed out as required.
        1) Where large irregularities of surface exist, apply furring strips not over 16 inch o.c. using wood shims to shim out to a true even plane.
        2) Electrical outlet boxes for switches, wall receptacles and fixtures should be extended outward to compensate for the added gypsum board thickness.
    b. Install boards as recommended by gypsum manufacturer and as noted hereinbefore.

3.10 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction and other causes during remainder of the construction period.

C. Remove and replace boards that are wet, moisture-damaged, and mold-damaged.
1. Indications that boards are wet or moisture-damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that boards are mold-damaged include, but are not limited to fuzzy or splotchy surface contamination and discoloration.

3.11 FIELD QUALITY CONTROL

A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

B. Above Ceiling Observation: Before Contractor installs gypsum board ceilings, A/E will conduct an above ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
   1. Notify A/E 7 days in advance of date and time when project, or part of project, will be ready for above-ceiling observation.
   2. Before notifying A/E, complete the following in areas to receive gypsum board ceilings:
      a. Installation of 80 percent of lighting fixtures, powered for operation.
      b. Installation, insulation, and leak and pressure testing of water piping systems.
      c. Installation of air duct systems.
      d. Installation of ceiling support framing.

END OF SECTION 09 21 16.00

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes following:
   1. Porcelain (paver) tile.
   2. Ceramic mosaic tile
   3. Crack-suppression membrane for thin-set tile installations.
   4. Metal edge strips installed as part of tile installations.

B. Related Sections include following:
   1. Division 03 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates, admixtures, and topping that may affect performance of installed tile.
   2. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
   3. Division 09 Section "Gypsum Board Assemblies" for cementitious backer units and glass-mat, water-resistant backer board.

1.2 DEFINITIONS

A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in “American National Standard Specifications for Installation of Ceramic Tile.”

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preliminary Meeting: Conduct meeting at Project site a minimum of 60 days before scheduled data of tile floor installation.
   1. Review Article “PROJECT CONDITIONS”.
   2. Review Article “EXAMINATION”.

B. Pre-installation Meeting: Conduct meeting at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." A/E will schedule and conduct meeting.
   1. Review mockup.
   2. Review requirements in ANSI 108.01 for substrates and for preparation by other trades.
   3. Flooring product manufacturer will have a technical installation representative available at job site at inception of installation to insure there are no conditions which will compromise installation of material, and that material is being installed according to industry standards, practices and manufacturers guidelines. Manufacturer’s technical representative will document and confirm that substrate, material, and installation are in compliance with manufacturer’s guidelines and accepted industry standards and practices.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Verification:
1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
2. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Metal edge strips in 6-inch lengths.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports
1. Tile setting and grouting products.
2. Slip-resistance test reports from qualified independent testing agency.

1.6 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Maintenance Data: Include cleaning methods, cleaning solutions recommended, stain removal methods, and polishes and waxes recommended.
2. Receipt for verification of extra stock.

1.7 MAINTENANCE MATERIALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Tile and Trim Units: Furnish quantity of full-size units equal to 5 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

A. Installers Qualifications: Work done under this Section of Specifications shall be performed by mechanics skilled and experienced in class of work involved. Workmanship shall be in accordance with best trade practices, and surface shall be true to line and free from waves and other imperfections. Joints between tiles shall be maintained uniform and even and properly grouted.
1. Installers shall be experienced in ANSI A108 standards and Tile Council of North America (TCNA) recommendations. A copy of these standards shall be present at jobsite.
2. Install shall meet one or more of following qualifications:
a. Installer is a five-star member of National Tile Contractors Association or a Travel of Excellence member of Tile Contractors' Association of America.
b. Installer's supervisor for Project holds International Masonry Institute's Foreman Certification.
c. Installer employs Ceramic Tile Education Foundation Certified Installers.

d. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of large format tile.

3. Foreman: It is recommended that a non-working project foreman be on-site, overseeing the work and implementing their Quality Control Plan.

B. Regulatory Requirements:
1. TCNA Handbook for Ceramic Tile Installation by Tile Council or North America, latest edition.
2. American National Standard Specifications for Installation of Ceramic Tile.

C. Mockups: First-in-place 25 sq.ft. shall serve as mockup. Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Mockup is to be viewed in lighting to which it will be subjected.
1. Build mockup of floor tile installation.
2. Build mockup of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of completed Work if undisturbed at time of Substantial Completion.
a. Do not proceed with remaining work until workmanship, color, and sheen are approved by A/E. Obtain A/E's acceptance of mockups before start at final unit of work.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

F. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or half tiles or larger set aside for use by Owner.
a. Broken tile, cutoffs smaller than 1/2 tile, and excess mortar and grout can be crushed and used for fill.
2. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.
3. Fold up metal banding, flatten, and place in designated area for recycling.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at levels indicated in referenced standards and manufacturer's written instructions.

B. Protection: Protect adjacent work surfaces during tile work. Close rooms or spaces to traffic, of all types, until mortar and grout have set.

C. Safety: Observe manufacturer’s safety instructions including those pertaining to ventilation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, following requirements apply for product selection:
   1. Products: Subject to compliance with requirements, provide one of products specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed material requirements and functional qualities of specified product. Requests for Architect/Engineer’s approval must be accompanied by “Substitution Request Form” and complete technical data for evaluation. All materials for evaluation must be received by Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.
   1. Where products are indicated on List of Finishes with color selected, provide sample or color chart to verify color match with substitution request.

C. Source Limitation for Surface Prep, Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
   1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregates, from single manufacturer.
   2. Obtain crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1/.2, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
   2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. FloorScore Compliance: Tile for floors shall comply with requirements of FloorScore Standard

D. Low-Emitting Materials: Tile flooring systems shall comply with testing and product requirements of California Department of Health Services’ Standard Practice for Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

E. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with following requirements:
   1. Refer to “List of Finishes”

F. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

G. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
   1. Where tile is in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

H. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 TILE PRODUCTS

A. Unglazed Porcelain (Paver) Tile (PFT): Flat tile as follows:
   1. Composition: Impervious natural clay or porcelain.
   2. Facial Dimensions: As indicated.
   3. Face Size Variation: Rectified.
   4. Thickness: As indicated.
   5. Face: Plain with cushion edges, unless otherwise noted.
   6. Dynamic Coefficient of Friction: Not less than 0.42.
   7. For latex-portland cement-mortared and -grouted paver tile, precoat with temporary protective coating.
   8. Basis-of-Design Product: Refer to “List of Finishes”.

B. Ceramic Mosaic Tile (CMT): Factory-mounted flat tile as follows:
   1. Composition: Vitreous or impervious natural clay or porcelain.
   2. Surface: Smooth, without abrasive admixture, unless otherwise noted
      a. Provide slip resistant surface with abrasive admixture in showers, drying areas, where floors could become wet, and where indicated.
   3. Module Size: 2 by 2 inches.
   4. Nominal Thickness: 1/4 inch.
   5. Face: Plain with cushion edges, unless otherwise noted.
   6. Dynamic Coefficient of Friction: Not less than 0.42.
   7. Basis-of-Design Product/Color: Refer to “List of Finishes.”

C. Glazed Paver Tile (PWT): Flat tile as follows:
   1. Composition: Semivitreous, vitreous, or impervious natural clay or porcelain.
   2. Facial Dimensions: As indicated.
   3. Face Size Variation: Rectified.
   4. Face: Plain with cushion edges, unless otherwise noted.
   5. Manufacturers:
   6. Basis-of-Design Product: Refer to “List of Finishes”

D. Wall Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
   1. Base for Thin-Set Mortar Installations: Straight, module size 6 by 6 inches, unless otherwise noted.
      a. Provide a 6-inch-high base, unless higher base is required by governing authority or indicated.
   2. External Corners for Thin-Set Mortar Installations: Surface bullnose.
   3. Internal Corners: Field-butted square corners except with coved base and cap angle pieces designed to fit with stretcher shapes.

E. Paver Tile Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer’s standard shapes:
   1. Base: Coved with surface bullnose top edge, unless otherwise noted.

2.4 CRACK-SUPPRESSION MEMBRANE

A. General: Manufacturer's product selected from following that complies with A 118.12 for high (greater than 1/8 inch) performance and is recommended by manufacturer for application indicated.
   1. Products: Provide any product that complies with "Waterproofing and Crack-Suppression Membranes" article above or one of following:
      a. Fabric-Reinforced Modified-Bituminous Sheet
         1) MAPEI Corp.; Mapeguard C.1 with Primer HM.
         2) Custom Building Products: Crack Buster Pro Crack Prevention Mat.
      b. Fabric-Reinforced, Fluid-Applied Membrane
         1) Laticrete International, Inc.; Laticrete Blue 92 Anti-Fracture Membrane.
         2) Custom Building Products: 9240 Waterproofing and Anti-Fracture Membrane.
      c. Fluid-Applied Membrane
         1) Custom Building Products; Fracture Free Crack Prevention Membrane.
         2) Merkrete Systems, Parex USA Inc.; Fracture Guard 7000.
         3) HB Fuller; TEC HydraFlex Waterproofing Crack Isolation Membrane.
         4) MAPEI Corp.; Mapelastic Aquadefense.

2.5 SETTING AND GROUTING MATERIALS

A. Products: Subject to compliance with requirements, provide one of following:
   1. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15
      a. HB Fuller; TEC Super Flex or TotalFlex 110 Silica Free Universal Mortar
      b. Custom Building Products; Flexbond-LFT Premium Crack Prevention Large Format Tile Mortar
      c. LATICRETE SUPERCAP, LLC; 4-XLT
      d. MAPEI Corporation; Keraflex Plus
   2. Polymer-Modified, Unsanded Tile Grout: ANSI A118.7
      a. ARDEX Engineered Cements; FG-C Microtec Unsanded Floor and Wall Grout/Grout Booster
      b. Bostik; Hydroment (Unsanded)/425
      c. C-Cure; Supreme 925/MP 923/CureCylic 938/Color Cure 945
      d. DAP; Durabond C150/Durabond DBL26
      e. Laticrete; 600 Series/LATICRETE 1776
      f. MAPEI; Keracolor U/Ultra Care Grout Maximizer
      g. Southern Grouts & Mortars; Dry-Set Grout Unsanded Polymer Modified Tile Grout/Southcrete 20 Acrylic Admix
      h. Summitville Tiles; SB687/SB775
      i. HB Fuller; TEC Unsanded AccuColor/TA Acrylic Grout Additive
      j. Custom Building Products: Polyblend HP High Performance Fine Aggregate Grout
   3. Polymer-Modified, Sanded Tile Grouts: ANSI A118.7
      a. Bostik; Vivid
      b. C-Cure
         1) AR Sanded Grout 922/MP Sanded 924
         2) CureCrylic 938
      c. Laticrete: Permacolor Select
      d. MAPEI, Keracolor S
      e. HB Fuller:
         1) Power Grout
         2) AccuColor Plus
      f. Custom Building Products: Polyblend Plus Sanded Grout
      g. DAP; Durabond ARB20/Durabond DBL26
      h. Southern Grouts & Mortars; Saltillo Grout Mix/Southcrete 20 Acrylic Admix
      i. Summitville Tiles; SB700/SB775 or SB776
      j. ARDEX Americas: FL Rapid Set, Flexible, Sanded Grout

B. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added to Project site.
2. For wall applications, provide mortar that complies with requirements for non-sagging mortar in addition to other requirements in ANSI A118.15.

C. Polymer-Modified, High-Performance, Tile Grout: ANSI A118.7, color as indicated.
1. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
a. Unsanded grout mixture for joints 1/8 inch and narrower.
b. Sanded grout mixture for joints 1/8 inch and wider.

2.6 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 07 Section "Joint Sealants."
1. Sealants shall comply with testing and product requirements of California Department of Health Services' "Standard Practice for Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
1. Products:
a. Dow Corning Corporation; Dow Corning 786.
b. GE Silicones; Sanitary 1700.
c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
d. Tremco, Inc.; Tremsil 600 White.
e. Laticrete International, Inc., Latasil Tile and Stone Sealant.
f. MAPEI, Mapesil
g. ARDEX Engineered Cements; SX 100% Silicone Sealant.
h. Custom Building Products: Commercial 100% Silicone Sealant.
i. HB Fuller; TEC AccuColor 100% Silicone Sealant.

D. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.
1. Products:
a. Bostik; Chem-Calk 550.
b. Degussa Building Systems; Sonneborn Sonolastic SL-2.
c. Pecora Corporation; NR-200 Urexpan/Dynatrol II-SG.
d. Tremco, Inc.; THC-900/THC-901.
e. Sika Corporation; Sikaflex – 2cSL.
f. MAPEI; Planipatch.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayment’s and Patching Compounds: ANSI A118.16 or ANSI A108.21; latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips and Cove: Angle or L-shape and cove, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications, white zinc alloy or stainless steel; ASTM A 666, 300 Series exposed-edge material.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of following:
      a. Blanke Corporation
      b. Ceramic Tool Company, Inc.
      c. Schluter Systems L.P.
      d. Profloor Series: Custom Building Products.

C. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
   1. Petroleum paraffin wax, fully refined and odorless, contains at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
   2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Floor/Grout Sealer: Manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.
   1. Products:
      a. Bonsal, American, an Oldcastle company.
      b. Bostik; CeramaSeal Grout Sealer.
      c. C-Cure; Penetrating Sealer 978.
      d. Custom Building Products; Grout Aqua Mix Sealer’s Choice Gold.
      e. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
      f. Summitville Tiles, Inc.; SL-15; Invisible Seal.
      g. MAPEI; Ultra Care Grout Sealer.

2.8 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

2.9 SOURCE QUALITY CONTROL

A. Manufacturer Services: Manufacturer assures product submitted is appropriate for application and environment in which it is to be installed, and that product is merchantable for service, free of visible and latent defects and will perform for purpose for which it is intended without compromise.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify substrate mix design for additives i.e. hardeners, moisture vapor reduction admixture, and other ingredients that might affect performance of installed tile.
2. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films or silicones, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
3. Verify that concrete surfaces for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.1 for installations indicated.
    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
4. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
5. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected and manufacturer has approved substrate for material to be installed without compromise.

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials, using mechanical methods recommended by manufacturer. Do not use solvents.

B. Provide concrete substrates for tile floors installed with thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
1. For tiles with all edges shorter than 15 inches, maximum allowable variation in tile substrate is 1/4 inch in 10 feet from required plane, with no more than 1/16-inch variation in 1 foot when measured from high points of surface.
2. For tiles with at least one edge 15 inches in length or longer, maximum allowable variation in tile substrate is 1/8 inch in 10 feet from required plane, with no more than 1/16-inch variation in 2 feet when measured from high points of surface.
3. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
4. Remove protrusions, bumps, and ridges by sanding or grinding.
5. All concrete substrates at least 28 days old, completely cured and free of hydrostatic conditions.
    a. If concrete additives, i.e., hardeners, moisture vapor reduction admixtures or other ingredients have been included in mix or suspected to be in mix that might affect performance of flooring installation, test bond.
        1) Perform bond and additional tests as recommended by TCNA and grout manufacturer. If tests do not produce satisfactory results, coordinate with concrete admixture manufacturer and grout manufacturer on possible solutions. Retest until a satisfactory result can be obtained.

C. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

D. Wall Preparation: Comply with ANSI A108.01, Section 2.5.
1. Gypsum board shall be installed per guidelines of ANSI A108.01, Section 3.5.

E. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

F. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules and apply to types of setting and grouting materials used.
   1. Tile and installation products must be installed per manufacturers' instructions and industry standards. Products should be mixed per manufacturers' instructions. Temperature limitations must not be exceeded, and shading or heat must be given as required. Work must also be protected from both weather and other trades.

B. TCNA Installation Guidelines: TCNA's "Handbook for Ceramic Tile Installation." Comply with TCNA installation methods indicated in ceramic tile installation schedules.
   1. Lay out tilework so as to minimize cuts less than one-half tile in size. Do not interrupt pattern through openings, unless otherwise noted. No staggered joints will be permitted.
   2. Locate cuts in both walls and floors so as to be least conspicuous.
   3. Align floor joints to give straight uniform grout lines parallel with walls. Align joints between floor and base tile. Align joints in both directions. Create transitions to other material or colors under door, unless otherwise noted.

C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
   1. Form internal angles square and external angles bullnosed, unless otherwise noted.

E. Provide manufacturer's standard trim shapes where necessary to eliminate tile edges, unless otherwise noted.

F. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

G. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
   1. Where tiles are specified or indicated to be whole integer multiple of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
   2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.

H. Lay out tile wainscots to next full tile beyond dimensions indicated.

I. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Locate joints in tile surfaces directly above joints in concrete substrates.
   2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
   3. Control joints and other sealant usage

a. Install control joints where tile abuts retaining surfaces such as perimeter walls, curbs, columns, wall corners, and directly over cold joints and control joints in structural surfaces conforming to architectural details.
b. Install control joint in floors at spacings as indicated in TCNA Installation Handbook, unless noted otherwise.
c. Rake or cut control joints through setting bed to supporting slab or structure. Keep joints free of mortar.
d. Install in accordance with TCNA Installation Handbook.
e. Fill joints with self-leveling polyurethane sealant and backing material specified in Division 07 Section “Joint Sealants”.
f. Fill joints around toilet fixtures with white silicone sanitary sealant. Refer to Division 07 Section “Joint Sealants”.

4. Expansion Joints
a. Keep expansion joints free of mortar and grout.
b. Use manufacturer’s expansion joint flashing when covering expansion joints with crack-suppression membranes.
c. Provide expansion joints directly over changes in material, over control and expansion joints in substrate, at juncture of floors and walls, at other restraining surfaces such as curbs, columns, bases, and wall corners, and where recommended by TCNA EJ171 Expansion Joint requirements.
d. Install sealant in expansion joints.
e. Provide sealant material at items penetrating tile work, unless otherwise indicated.
f. Provide sealants and related materials in accordance with cited ANSI and TCNA requirements.

J. Grout tile to comply with requirements of following tile installation standards:
1. For ceramic tile grouts (polymer-modified tile grouts), comply with ANSI A108.10.

K. At “wet walls”, install cementitious backer units and treat joints to comply with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.4 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack-suppression membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.
1. Crack-suppression membrane must be installed over entire substrate.

B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.5 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in Floor Tile Installation Schedule, including those referencing TCNA installation methods and ANSI A108 Series of tile installation standards.
1. Thin set method, floors and walls, general
a. Apply mortar with notched trowel using scraping motion to work material into good contact with surface to be covered. Maintain 90 percent coverage on back of tile and fully bed all corners, unless otherwise noted.
1) For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
a) Tile floors consisting of tiles 8 by 8 inches or larger.
b. Apply only as much mortar as can be covered within allowable windows as recommended by mortar manufacturer or while surface is still tacky.
c. When installing large tiles, ceramics or mosaics, trowel small quantity of mortar onto back of each tile or sheet of tiles.
d. Set tiles in place and rub or beat with small beating block.
e. Beat or rap tile to ensure proper bond and also to level surface of tile.
f. Align tile to show uniform joints and allow to set until firm.

g. Clean excess mortar from surface of tile with wet cheese cloth (not a sponge) while mortar is fresh.
h. Allow face mounted tile to set until firm before removing paper and before grouting.
i. Sound tile after setting. Replace hollow sounding tiles.

2. Bonding large format tile for coverage and support
   a. Following installation techniques are required to ensure 95 percent coverage of bonding surface of larger tiles and provide full support of edges and corners, in accordance with procedures in ANSI A108 Series tile installation standards. Large tiles are generally considered to be 8 by 8 inch and greater.
      1) Select a notched trowel sized to facilitate proper coverage.
      2) Key mortar into substrate with flat side of trowel.
      3) Comb with notched side of trowel in one direction.
      4) Firmly press tiles into mortar and move them perpendicularly across ridges, forward and back approximately 1/8 to 1/4 inch to flatten ridges and fill valleys.
      5) This method can produce maximum coverage, with corners and edges fully supported, without backbuttering or beat in.
      6) Periodically remove and check a tile to assure proper coverage is being attained.
      7) Sound tile after setting. Replace hollow sounding tile.

B. Joint Widths: Install tile on floors with following joint widths:
   1. Ceramic Mosaic Tile: 1/16 inch.
   2. Porcelain (Paver) Tile: 3/8 inch, unless otherwise noted or recommended by manufacturer for application indicated..

C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
   1. Locate transition under doors, unless otherwise noted.

D. Floor/Grout Sealer: Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

3.6 WALL (BASE) TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in Wall Tile Installation Schedule, including those referencing TCNA installation methods and ANSI setting-bed standards.

B. Joint Widths: Install tile on walls with following joint widths:
   1. Ceramic Mosaic Tile: 1/8 inch.
   2. Paver Wall Tile: 3/8 inch, unless otherwise noted or recommended by manufacturer for application indicated.

3.7 ADJUSTING/CLEANING AND PROTECTING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove latex-Portland cement grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

C. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

E. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.8 INTERIOR, FLOOR TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor
1. Tile Installation: Interior floor installation on concrete; thin-set mortar on crack isolation membrane; TCNA F125-Full and ANSI A108.1.
a. Tile Type: Unglazed paver tile and unglazed ceramic mosaic tile.
b. Thin-Set Mortar: Improved modified dry-set.
c. Crack Suppression Membrane Installed: Full coverage of substrate.
d. Grout: Polymer-modified, high-performance, sanded grout.

3.9 INTERIOR, WALL (BASE) TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Masonry or Concrete
1. Tile Installation: Interior wall installation over sound, dimensionally stable masonry or concrete; thin-set mortar; TCNA W202I and ANSI A108.5.
a. Tile Type: Ceramic mosaic tile and paver wall tile.
b. Thin-Set Mortar: Improved modified dry-set mortar as recommended by manufacturer for application indicated.
c. Grout: Polymer-modified, high-performance, sanded.

B. Interior Wall Installations, Wood or Metal Studs or Furring:
1. Tile Installation: Interior wall installation over cementitious backer units; thin-set mortar; TCNA W244C and ANSI A108.5.
a. Tile Type: Ceramic mosaic tile.
b. Grout: Polymer-modified, high-performance, sanded.

END OF SECTION 09 30 00

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes acoustical panels and exposed suspension systems for ceilings.

B. Related Sections include the following:
   1. Division 07 Section “Acoustical Joint Sealants” for general requirements.
   2. Division 09 Section “Suspended Modular Ceiling Modules” for coordination with ACT.

1.2 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Pre-installation Meeting: Conduct meeting at Project site.
   1. Agenda shall include project conditions, coordination with work of other trades, layout of items which penetrate ceilings.

C. Sequencing
   1. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generated activities and wet work have terminated, and overhead work is completed, tested, and approved.
   2. Install acoustic units after interior wet work is dry.
   3. Ensure that products of this Section are supplied to affected trades in time to prevent interruption of construction progress.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including:
   1. Preparation instructions and recommendations.
   2. Dimensions, load carrying capacity, and performance standards compliance.
   3. Storage and handling requirements and recommendations.
   4. Installation and maintenance instructions.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Ceiling suspension system components, including method of suspension where interference exists.
   2. Structural members to which suspension systems will be attached.
   3. Method of attaching hangers to building structure, including structural members to which suspension system will be attached.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Items penetrating finish ceiling and ceiling-mounted items including the following:
    a. Lighting fixtures
    b. Diffusers
    c. Grilles
    d. Speakers
    e. Sprinklers
    f. Perimeter moldings
6. Minimum Drawing Scale: 1/8 inch = 1 foot.

B. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry Underwriter's Laboratory certification of NRC and CAC.
1. Provide a letter from the manufacturer certifying materials contain less than 1-percent asbestos by polarized light microscopy (PLM) analysis.

1.6 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Maintenance Data: For finishes to include in maintenance manuals.
2. Receipt of extra materials.

1.7 EXTRA (MAINTENANCE) MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Acoustical Ceiling Panels: Full-size panels equal to 5.0 percent of quantity installed.
2. Hold-Down Clips: Equal to 2 percent of quantity installed.

B. Replacement Stock: In addition to the maintenance stock specified above, provide extra replacement stock of acoustical materials, consisting of a minimum of one percent of area of each size, type, and thickness installed on the job. This extra stock is for replacement of damaged materials during the 60-day period following Substantial Completion, when the Owner's agent cannot ascertain the party responsible for the damage. Replacement stock that is not used shall be furnished to the Owner as extra materials.
1. Replacement Stock may include broken-box quantities.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

D. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
1. Separate clean waste gypsum and cellulose products from contaminants for recycling in accordance with the Waste Management Plan. Do not include any gypsum or cellulose product coated with glass fiber, vinyl, decorative paper, print, or other finish. Place in designated area and protect from moisture and contamination.

2. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or set aside 2 sq.ft. or larger for Owner to use as extra materials.
3. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.
4. Existing panels removed from project.
    a. Return to manufacturer for renewal/refinishing program.

E. Indoor Air Quality
1. Temporary Ventilation
    a. Ventilate products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant source and residues. Provide a temperature range of 60 degrees F. minimum to 90 degrees F. maximum continuously for minimum 72 hours. Do not ventilate within limits of work, if at all possible.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Refer to “List of Finishes” on drawings.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain acoustical panel ceiling and suspension system from one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Performance Requirements: Panels shall meet the following minimum performance criteria:
1. ASTM E1264, Class A materials.
2. Moisture Resistant: No visible sag at of 90-percent relative humidity and 104 degrees F.

B. Kitchens and associated rooms (storage, locker, and toilet) excluding require aluminum, aluminum faced galvanized steel or stainless steel grid and lay-in panels with smooth, unperforated vinyl, polyester film (Mylar), or similar surface.

C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
    a. Smoke-Developed Index: 50 or less.

D. Verify ceiling products comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance's, unless otherwise indicated.
   1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
   1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by A/E from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

C. Panel Characteristics: Comply with requirements indicated on "List of Finishes".

D. Humidity Resistance: Where indicated in "Acoustical Panel Ceiling Product Schedule," panels shall be dimensionally stable at up to 100 percent relative humidity at temperatures ranging from 32 to 104 deg F. without having to acclimatize tiles.

E. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, and bacterial growth when tested according to ASTM D3273 and evaluated according to ASMT D3274 or ASTM G21. KEEP JUST ADDED

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
   1. Power-Actuated Fasteners in concrete: Not allowed.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
   1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper, unless otherwise noted.
   2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch diameter wire (fka 9 gauge).

E. Hanger Rods or Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch thick, galvanized steel sheet complying with ASTM A 653, G90 coating designation; with bolted connections and 5/16-inch diameter bolts.

G. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.
   1. Provide at the following locations and where indicated:
      a. ACT located in vestibules, toilet rooms, and locker rooms.

2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, pre-painted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653, not less than G30 coating designation, with prefinished 15/16-inch wide metal caps on flanges.
   1. Structural Classification: Intermediate duty system.
   2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
   3. Face Design: Flat, flush.
   4. Cap Material: Steel or aluminum cold-rolled sheet.
   5. Cap Finish: Painted white, unless otherwise noted.
   6. Provide this suspension system unless otherwise noted.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
   1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
   2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
   3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
   4. Provide radiused corner edge molding trim at bullnose block.

2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, non-staining latex sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. BOSS 826 Acoustical Sound Sealant; Accumetric LLC.
      b. RCS 20 Acoustical; GE Construction Sealants.
      c. Acoustical Sealant GSC; Grabber Construction Products.
      d. OSI Pro-Series SC-175 Acoustical Sound Sealant; Henkel Corp.
      e. AC-20 FTR or AIS-919; Pecora Corp.
      f. Smoke-N-Sound Acoustical Sealant; Specified Technologies, Inc.
      g. Quiet Seal Pro; Serious Energy, Inc.
      h. SHEETROCK Acoustical Sealant; USG Corp.
      i. CP 506 Smoke and Acoustical Sealant; Hilti.
      j. Titebond GREENchoice Professional Acoustical Smoke and Sound Sealant: Franklin International.
   2. Acoustical joint sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the Project Conditions.

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

C. Refer to Room Finish Schedule, Legend and Reflected Ceiling Plan for spaces to receive acoustical ceiling tile. Grid shall be laid out and coordinated for lighting fixtures and mechanical system items. Furnish layouts for anchors, clips, and other ceiling anchors whose installation is specified in other Sections.

D. The installation of the ceiling shall be done prior to the installation of shelving, built-in counters, and finished floors; but after the other work in the room has been completed, including painting, unless otherwise approved by the A/E.

E. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:
   1. Install suspension wires 4 foot on center, maximum in both directions.
   2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
   3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   4. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   5. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

6. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structures.
    a. In installations where hanger wire are wrapped through or around main runners, the wire loops shall be tightly wrapped and sharp bent to prevent any vertical movement or rotation of the member within the loops. The wire must be wraped around itself a minimum of three full turns (360 degree each) within a 3-inch length. For safety purposes, the bottom of the hanger wires shall either be cut close to the vertical portion of the wire or shall be bent upward parallel to the vertical portion of the hanger wire.
7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, that extend through forms into concrete.
    a. Powder-actuated fasteners are not allowed.
8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
9. Do not attach hangers to steel deck tabs.
10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
11. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications and so deflection does not exceed 1/360 of the span.

C. Secure bracing wires, if required by authorities, with jurisdiction, to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
    a. As indicated on reflected ceiling plans.
2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. Install hold-down clips in areas indicated, space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.5 ACOUSTICAL PANEL CEILING PRODUCT SCHEDULE

A. Refer to “List of Finishes” on drawings.

END OF SECTION 09 51 13

SECTION 09 54 34 - SUSPENDED MODULAR CEILING MODULES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Suspended acoustical modular ceiling modules.
   2. Cable hangers and fasteners.

B. Related Sections:
   1. Division 05 Section “Metal Decking” for coordination with hanger system.
   2. Division 23 Sections – HVAC.
   3. Division 26 Sections - Electrical.

1.2 REFERENCES

A. Test Methods:
   1. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   2. ASTM E 84/CAN/ULC S102 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Meeting: Conduct meeting at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, specified.
   1. Include construction details, mounting, material descriptions, dimensions of individual components and profiles, and finishes for ceiling units specified.
   2. Include furnished specialties and accessories.

B. Shop Drawings
   1. Include plans, elevation and sections, and mounting devices and details.

C. Samples for Verification: Full-width by approximately 36-inch long Sample.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the item involved:
   1. Structural members to which suspension devices will be attached.
   2. Items penetrating or covered by sound-absorbing ceiling units include the following:
      a. Lighting fixtures
      b. Air outlets and inlets
      c. Speakers
      d. Alarms
      e. Sprinklers

1.6 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O & M Manuals only. Do not submit with other ACTION and INFORMATIONAL SUBMITTALS:

1. Maintenance Data: For sound-absorbing ceiling units to include in maintenance manuals. Include manufacturers written cleaning and stain-removal recommendations.

1.7 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide modules and method of attachment by a single manufacturer.

B. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store the Acoustical Arborisa® modular ceiling modules in an interior location and keep in cartons prior to installation to avoid damage.

B. Exercise care in moving and opening cartons to prevent damage to the module face.

C. Handle modules carefully to avoid damaging units in any way.

D. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or set aside for Owner to use as extra materials.
2. Separate corrugated carboard in accordance with Waste Management Plan and place in designated areas for recycling.
3. Fold up metal banding, flatten, and place in designated area for recycling.

E. Indoor Air Quality
1. Temporary Ventilation
a. Ventilate products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant source and residues. Provide a temperature range of 60 deg. F minimum to 90 deg. F maximum continuously for minimum 72 hours. Do not ventilate within limits of work, if at all possible.

1.9 PROJECT CONDITIONS

A. Space Enclosure:
1. Acoustical Modules: All wet work must be complete and dry prior to installation. Installation shall be carried out where the temperature is between 40 degrees F and 90 degrees F. These temperature conditions must be maintained throughout the life of the warranty.
2. Lighting: Do not install sound-absorbing ceiling units until a permanent level of lighting is provided on surfaces to receive the units.
3. Air-Quality Limitations: Protect sound-absorbing ceiling units from exposure to airborne odors, such as smoke and install units under conditions free from odor contamination of ambient air.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated in the “List of Finishes” on drawings.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. General Requirements for Sound-Absorbing Ceiling Units: Provide sound-absorbing baffles that comply with the testing and product requirements of the California Department of Health Services” Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers”.

B. Fire-Test-Response Characteristics: Provide sound-absorbing ceiling units meeting the following requirements as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spred Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.
   2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.

2.3 MODULE UNITS

A. Modules:
   1. Pattern: As indicated in “List of Finishes”.
   2. Surface Texture: Smooth texture
   3. Composition: PET plastic (up to 60% recycled) + Metal brackets
   4. Color: As indicated in “List of Finishes”.
   5. Module Size: As shown on drawings

2.4 ATTACHMENT SYSTEM

A. Installation Hardware:
   1. 1/32” stainless braided Wire, stainless connector plates, and Griplock tensioning hardware.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examination:
   1. Field verify each wall area and establish layout of modules. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation. Module substructure shall be level and plumb. Module substructure shall be structurally sound as determined by that subcontractor’s engineer. Module substructure shall be free of defects detrimental to work and erected in accordance with established building tolerances.
   2. Coordinate module layout with mechanical, electrical and sprinkler fixtures as required.
   3. Coordinate delivery of such items to project site.

B. Proceed with installaton only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install modules in accordance with the manufacturer’s instructions and in compliance with the authorities having jurisdiction.

B. Erect modules level and plumb, in proper alignment in relation to substructure framing and established lines.

C. Module anchorage shall be structurally sound and per engineering recommendations.

D. Locate and place wall modules level, plumb, and at indicated alignment with adjacent work. (Optional if vertical hung application)

E. Do not locate the modules in the direct sunlight or sagging from heat and color fade may occur.

3.3 ADJUSTING AND CLEANING

A. Replace damaged and broken modules.

B. Routine maintenance of modules should consist of: Blot excess spills from material quickly. Wipe with a damp cloth. If stain persists, apply small quantities of carpet or upholstery shampoo solution with a damp cloth. Blot well with a clean cloth after each application of the solution. Warning, avoid excessive amounts of water. Note: Ensure adequate ventilation if the product is likely to be subject to excessive moisture

END OF SECTION 09 54 34

SECTION 09 54 36 – SOUND-ABSORBING CEILING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Sound-absorbing ceiling baffle, custom-fabricated.
2. .
2. Cable hangers and fasteners.

B. Related Sections:
1. Division 23 Sections – HVAC.
2. Division 26 Sections - Electrical.

1.2 REFERENCES

A. Test Methods:
1. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
2. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
3. ASTM E 795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Meeting: Conduct meeting at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, specified.
1. Include construction details, mounting, material descriptions, dimensions of individual components and profiles, and finishes for ceiling units specified.
2. Include furnished specialties and accessories.

B. Shop Drawings
1. Include layout and sections, and mounting devices and details.

C. Samples for Verification: Full-width by approximately 36-inch long Sample.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the item involved:
1. Structural members to which suspension devices will be attached.
2. Items penetrating or covered by sound-absorbing ceiling units include the following:
a. Lighting fixtures
b. Air outlets and inlets
c. Speakers
d. Alarms
e. Sprinklers

1.6 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O & M Manuals only. Do not submit with other ACTION and INFORMATIONAL SUBMITTALS:

1. Maintenance Data: For sound-absorbing ceiling units to include in maintenance manuals. Include manufacturers written cleaning and stain-removal recommendations.

1.7 QUALITY ASSURANCE

A. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

C. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or set aside for Owner to use as extra materials.
2. Separate corrugated carboard in accordance with Waste Management Plan and place in designated areas for recycling.
3. Fold up metal banding, flatten, and place in designated area for recycling.

D. Indoor Air Quality
1. Temporary Ventilation
a. Ventilate products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant source and residues. Provide a temperature range of 60 deg. F minimum to 90 deg. F maximum continuously for minimum 72 hours. Do not ventilate within limits of work, if at all possible.

1.9 PROJECT CONDITIONS

A. Space Enclosure:
1. Environmental Requirements: All wet work must be complete and dry prior to installation. Installation shall be carried out where the temperature is between 40 degrees F and 90 degrees F. These temperature conditions must be maintained throughout the life of the warranty.
2. Lighting: Do not install sound-absorbing ceiling units until a permanent level of lighting is provided on surfaces to receive the units.
3. Air-Quality Limitations: Protect sound-absorbing ceiling units from exposure to airborne odors, such as smoke and install units under conditions free from odor contamination of ambient air.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated in the "List of Finishes" on drawings or comparable products from the other listed manufacturers.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The "Substitution Request Form" and complete technical data for evaluation must accompany requests for A/E's approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. General Requirements for Sound-Absorbing Ceiling Units: Provide sound-absorbing baffles that comply with the testing and product requirements of the California Department of Health Services" Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers".

B. Fire-Test-Response Characteristics: Provide sound-absorbing ceiling units meeting the following requirements as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spred Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.
   2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.

2.3 MANUFACTURED UNITS

A. Baffles
   1. Shape: As indicated in "List of Finishes".
   2. Surface Texture: Smooth texture.
   3. Composition: PET plastic (up to 60% recycled).
   4. Color: As indicated in "List of Finishes".
   5. Size: As shown on drawings.
   6. Sound Absorption (ASTM C 423): Sabin sound absorption as follows:
      a. Minimum Sabins 16.75 at 250 Hz, 26.07 at 500 Hz, 40.70 at 1000 Hz, 58.64 at 2000 Hz.

B. Cloud Baffles
   1. Shape/Size: Circle as indicated.
   2. Color: As indicated in "List of Finishes".
   3. Sound Absorption (ASTM C 423): Sabin sound absorption as follows (based on square baffle):
      a. Minimum Sabins 44.98 at 250 Hz, 64.84 at 500 Hz, 93.71 at 1000 Hz, 108.31 at 2000 Hz.
   4. Mounting Accessories: Threaded rod.

2.4 ATTACHMENT SYSTEM

A. Installation Hardware: Threaded rod.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examination: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product instalaltion in accordance with manufacturer's instructions.
   1. Field verify each area and establish layout. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation.
   2. Coordinate layout with mechanical, electrical and sprinkler fixtures as required.
   3. Coordinate delivery of such items to project site.

B. Proceed with installaton only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install baffles in accordance with the manufacturer's instructions and in compliance with the authorities having jurisdiction.

3.3 ADJUSTING AND CLEANING

A. Follow manufacturer’s instructions for cleaning baffles soiled during installation. Replace baffles that cannot be cleaned to as new condition.

B. Keep site free from accumulation of waste and debris.

END OF SECTION 09 54 36

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Resilient base.
   2. Resilient molding accessories.
   3. Edge-protection and transition profiles for floors.

B. Related Sections:
   1. Division 09 Section “Tiling” for coordination.
   2. Division 09 Section "Tile Carpeting” for coordination.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Project Site.
   1. Convene in conjunction with associated flooring materials conferences.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods
   4. Include fire-resistance testing.

B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 1-1/2 inches long, of each resilient product color, texture, and pattern required.

1.4 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Receipt for extra materials.

1.5 MAINTENANCE MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.6 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Include at least one inside and one outside corner.
   2. Coordinate mockups in this Section with markups specified in adjacent flooring in other Sections.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless A/E specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F and maintain relative humidity between 40 to 60%.
   1. Stack cartons squarely on top of one another, do not over stack cartons and protect corners from damage by tow-motors and other traffic.
      a. Do not flex, bend, or stand cartons on end never double stack pallets.
   2. Store on a dry, flat, level surface.

B. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or set aside for Owner to use as extra materials, if 4 foot or longer.
   2. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.
   3. Fold up metal banding, flatten, and place in designated area for recycling.

C. Indoor Air Quality
   1. Temporary Ventilation
      a. Ventilate products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant source and residues. Provide a temperature range of 60 degrees F. minimum to 90 degrees F. maximum continuously for minimum 72 hours. Do not ventilate within limits of work, if at all possible.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 85 deg F, in spaces to receive resilient products during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. Maintain the ambient relative humidity between 40 percent and 60 percent during installation.

C. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 85 deg F.

D. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   2. Products: Subject to compliance with requirements, provide one of the products specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The "Substitution Request Form" and complete technical data for evaluation must accompany requests for A/E's approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by a qualified testing agency by testing identical products.
   1. Critical Radiant Flux Classification (ASTM E 648 or NFPA 253): Class I (not less than 0.45 watts per cm^2.
   2. Smoke Generation (ASTM E 662 or NFPA 258): Maximum specific optical density of 450 or less.

B. Accessibility: Transitions and adaptors shall comply with accessibility requirements of the U.S. Architectural and Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1 as required by local authorities with jurisdiction.

2.3 RESILIENT BASE (RB)

A. Resilient Base:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the as indicated on the "List of Finishes.

B. Resilient Base Standard: ASTM F 1861.
   1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
   2. Manufacturing Method: Group I (solid, homogeneous) or Group II (layered).
   3. Style and Location: Style B, Cove: Provide unless otherwise noted or required by governing authority.

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches, unless otherwise noted.

E. Lengths: Cut lengths, 48 inches long.

F. Outside Corners: Factory pre-formed or factory precut or job formed. Corners must be a minimum of 4 inches in length each way.

G. Inside Corners: Factory pre-formed or job formed.

H. Finish: Satin.

I. Colors and Patterns: Refer to "List of Finishes".

2.4 RESILIENT MOLDING ACCESSORY (RMA)

A. Material: Rubber, unless otherwise noted.
   1. Where indicated, provide extruded aluminum with mill finish of width shown, of height required to protect exposed edges of floor coverings, and in maximum available lengths to minimize running joints.

B. Profile and Dimensions: As indicated.
   1. General, provide where meeting unfinished floor or flooring of different material transitions.

a. Comply with accessibility requirements for change in level and slope requirement for ramps.

C. Colors and Patterns: Refer to “List of Finishes”.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
1. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' *Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.*

C. Metal Edge Strips, where indicated: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.
1. Basis-of-Design: Refer to “List of Finishes” and transition details.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
2. Permanent, operational HVAC systems are highly recommended. If alternate system is utilized, it must provide proper control of both temperature and humidity per manufacturers requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Do not install resilient products until they are same temperature as the space where they are to be installed.
1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

C. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.
1. Substrates shall be free of all dust, loose particles, solvents, paint, grease, oil, wax, alkali, sealing/curing and parting compounds, old adhesive and other foreign material, which could affect the installation and adhesive bond to substrate. All substrate contaminates must be mechanically removed prior to the installation of the flooring.
a. Do not use liquid solvents or adhesive removers.
b. Do not use oil-based sweeping compounds.
c. Note: Permanent and non-permanent markers, pens, crayons, paint, or similar marking tools used to mark the substrate or back of resilient flooring material may cause migratory staining not covered by manufacturer’s warranty.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
   1. Exception: Resilient base shall not wrap 1-inch thick worksurface supports between workstations.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
      a. Form without producing discoloration (whitening) at bends.
   2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 4 inches in length.
      a. Butt one piece to corner then cope/scribe next piece to fit.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Vinyl composition floor tile (VCT) for patching of existing as required to accommodate new work.
2. Solid vinyl floor tile (SVT).

B. Related Sections:
1. Division 01 Section “Alternate” for description of alternates affecting work of this Section.
2. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preliminary Meeting: Conduct meeting at Project site a minimum of 60 days before scheduled date of “Resilient Tile Flooring” installation.
1. Review Article “FIELD CONDITIONS”.
2. Review Article “EXAMINIATION”.

B. Pre-installation Meeting: Before resilient tile installation, conduct a meeting at Project site to review mock-ups, joint locations, transitions, installation methods, and pattern layouts. A/E will schedule and conduct meeting.
1. Flooring manufacturer shall have a representative at the Pre-installation meeting.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including fire-test-response.

B. Installation Drawings: Show details indicating direction and pattern.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1.4 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIALS

A. Leave where directed at Project site, any remaining full size pieces of each type, color, pattern, and size for Owner’s maintenance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

B. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:

1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or set aside for Owner to use as extra materials.
2. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.
3. Fold up metal banding, flatten, and place in designated area for recycling.

C. Indoor Air Quality
1. Temporary Ventilation
a. Ventilate products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant source and residues. Provide a temperature range of 60 deg F minimum to 90 deg F maximum continuously for minimum 72 hours. Do not ventilate within limits of work, if at all possible.

1.7 QUALITY ASSURANCE

A. Manufacturers Qualifications: Flooring product manufacturer will have a technical installation representative available at the job site at the inception of the installation to insure there are no conditions which will compromise the installation of the material and that the material is being installed according to industry standards, practices and manufacturers guidelines. The manufacturer's technical representative will document and confirm that the substrate, material, and installation are in compliance with manufacturer's guidelines and accepted industry standards and practices.
1. Any noticed defect with the product or installation system will require the response of the manufacturer's technical field service personnel on site to determine cause, correction or replacement.

B. Installer's Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation method.

1.8 FIELD CONDITIONS

A. General: The installations area must be fully enclosed, weathertight, and climate controlled. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
1. 48 hours (minimum) before installation.
2. During installation.
3. 48 hours after installation.

B. Maintain the ambient relative humidity between 40 and 60 percent during installation. Dewpoint must be avoided. The substrate must be at least 5 degrees above dewpoint to be considered acceptable.

C. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

D. Close spaces to traffic during floor tile installation.

E. Close spaces to traffic for 48 hours after floor tile installation.

F. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide product by the manufacturers specified.
   2. Products: Subject to compliance with requirements, provide one of the products specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The "Substitution Request Form" and complete technical data for evaluation must accompany requests for A/E's approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.
   1. Where products are indicated on List of Finishes with colors selected, provide sample to verify color match with substitution request.

C. Source Limitations: Obtain resilient tile flooring of same standard, class and type from one manufacturing plant to minimize size variations. Flooring from one manufacturer but separate plants is not acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by a qualified testing agency by testing identical products.
   1. Critical Radiant Flux Classification (ASTM E 648 or NFPA 253): Class I (not less than 0.45 watts per cm^2).
   2. Smoke Generation (ASTM E 662 or NFPA 258): Maximum specific optical density of 450 or less.

B. Accessibility: Flooring shall comply with accessibility requirements of the U.S. Architectural and Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1 as required by local authorities with jurisdiction.
   1. Comply with ASTM D 2047, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring: Exceeds Federal Standards and ADA requirements for slip-resistance.

2.3 SOLID VINYL FLOOR TILE (SVT)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified in "List of Finishes":

B. Tile Standard: ASTM F 1700.
   1. Class: As indicated by product designations in "List of Finishes".
   2. Type: Type A, smooth surface.

C. Thickness: 0.120 inch.

D. Size: As indicated by product designations in "List of Finishes".

E. Colors and Patterns: Refer to "List of Finishes."

2.4 VINYL COMPOSITION FLOOR TILE (VCT)

A. Retain from Owner's attic stock to match existing adjacent VCT.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated and coordinate with substrate. Note: A primer may be required.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
   1. Adhesives shall be approved by manufacturer for use over concrete substrates with RH of less than 95 percent (ASTM F2170) and maximum pH of 10.
      a. Where results of relative moisture testing of concrete per ASTM F 2170 exceed the 95 percent relative humidity moisture level work to remedy will be by change order. Contractor shall propose a solution as recommended by the flooring manufacture.

C. Floor Polish at VCT only: Provide protective liquid floor polish products as recommended by manufacturer and coordinated with Owner's maintenance staff.

2.6 SOURCE QUALITY CONTROL

A. Manufacturer Services: Manufacturer assures the product submitted is appropriate for the application and environment in which it is to be installed and that the product is merchantable for service, free of visible and latent defects and will perform for the purpose for which it is intended without compromise.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
   1. Verify substrate mix design for additives, i.e. hardeners, moisture vapor reduction admixture and other ingredients that might affect performance of installed flooring.
      a. Vinyl is particularly sensitive to the influence of abatement chemicals. Verify substrate is free of all chemical, residue, if abatement of previous flooring with hazardous materials has occurred.
   2. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, curing compounds, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected and manufacturer has approved substrate for material to be installed without compromise.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
   1. Bond Test: An adhesive bond test must be performed using the actual flooring materials and adhesive to be installed. The tests area must be a minimum of 36 by 36 inches and remain in place for at least 72 hours and then evaluated for bond strength to the substrate.

B. Concrete Substrates: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
    a. Mechanically remove contamination of the substrate that may cause damage to the resilient flooring material. Permanent and non-permanent markers, pens, crayons, paint, etc., must not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and stain the flooring material.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
    1. Underlayment shall be steel troweled smooth and trowel marks showing through installed tile shall be reason to remove the tile and sand out trowel marks.

D. Floor covering shall not be installed over expansion joints.

E. Do not install floor tiles until they are same temperature as space where they are to be installed.
    1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Adhere floor tiles to flooring substrates using manufacturer recommended method for materials and substrate indicated. Produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
    1. Tiles should be lightly butted together when placing the flooring into adhesive.
    2. Do not force tiles together creating a ledge condition at the seams and corners. Sliding tiles will result in forcing the adhesive out between the seams.
    3. Periodically, lift the corner of an installed tile to ensure proper transfer of adhesive.
    4. Roll floor in both directions with a 100 pound three-section roller. Use a small hand roller in areas that cannot be reached with a large roller.
    5. Roll the flooring in both directions using a 100 pound three-section roller.

6. Inspect the floor surface, especially seams, and remove any adhesive on the surface.
7. Install adhesive as recommended for the site conditions and follow adhesive label for proper use.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:
1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
1. No traffic for 24 hours after installation.
2. No heavy traffic, rolling loads, or furniture placement for 72 hours after installation.

D. Floor Polish at VCT only: Wait 72 hours after installation before performing initial cleaning. Remove soil, visible adhesive and surface blemishes from floor tile surfaces before applying liquid floor polish in full accordance with manufacturer’s instructions.
1. Apply two coats, minimum allowing 24 hours of drying time between each coat.
2. Coordinate type of polish with manufacturer and Owner’s maintenance department.

E. Cover floor tile until Substantial Completion.

END OF SECTION 09 65 19

SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes modular carpet tile.

B. Related Sections include the following:
1. Division 01 Section “Indoor Air Quality Requirements” for coordination with indoor air quality requirements.
2. Division 03 Section “Cast-In-Place Concrete” for moisture barrier and slab requirements, including coordination with potential admixtures or toppings that may affect performance of installed floors.
3. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.
4. Division 12 Section “Entrance Carpet Tile” for entrance carpet tiles.

1.2 REFERENCES

A. Carpet and Rug Institute:
1. The Carpet Primer
2. Carpet Installation Standard

B. ASTM Standards:
1. ASTM F-1869 – Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Calcium Chloride.
2. ASTM F-710 – Standard Practice for Preparing Concrete to Receive Resilient Flooring.
3. ASTM F-2170 – In-situ Relative Humidity Testing.
4. ASTM F3191-16 – Standard Practice for Field Determination of Substrate Water Absorption (Porosity).

1.3 DEFINITIONS

A. Carpet Terminology: Refer to Carpet and Rug Institute (CRI) – "Carpet Installation Standard, Appendix."

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preliminary Meeting: Conduct meeting at Project site a minimum of 60 days before scheduled date of carpet tile installation.
1. Review Article “PROJECT CONDITIONS” requirements.
2. Review Article “EXAMINATION” requirements.

B. Preinstallation Meeting: Conduct meeting at Project site.
1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
   a. Review delivery, storage, and handling procedures.
   b. Review ambient conditions and ventilation procedures.
   c. Review subfloor preparation procedures.
2. Flooring product manufacturer will have a technical installation representative available at the jobsite at the inception of the installation to insure there are no conditions which will compromise the installation of the material and that the material is being installed according to industry standards, practices and manufacturers guidelines. The manufacturer’s technical representative will document and confirm that the substrate, material and installation are in compliance with manufacturer’s guidelines and accepted industry standards and practices.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include manufacturer's written data on physical characteristics, durability, and fade-resistance.
   2. Include manufacturer’s written installation recommendations for each substrate.

B. Shop Drawings: For carpet tile installation, show the following:
   1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
   2. Carpet tile type, color, and dye lot.
   3. Type of subfloor.
   4. Type of installation.
   5. Pattern of installation.
   6. Pattern type, location, and direction.
   7. Pile direction.
   8. Type, color, and location of inserts and borders.
   9. Type color, and location of edge transition, and other accessory strips.
   10. Transitions details to other flooring materials.

C. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
   1. Carpet Tile: Full-size Sample.
   2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch long Samples.

1.6 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Manufacturer’s written installation recommendations for each type of substrate.
   1. If the carpet and/or adhesive manufacturer have products with specific installation instructions, then the carpet and/or adhesive manufacturer shall make those installation instructions available.

B. Manufacturers Certification: Manufacturer shall provide a letter on company letterhead stating substrate, material, and installation are in compliance with manufacturer’s guidelines and accepted industry standards and practice. Certification letter shall include a summary written as to observations, conversations, instructions, condition concerns, corrections and other pertinent information.

1.7 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
      a. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
      b. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
   2. Warranty: Special warranty specified in this Section.
   3. Receipt for extra materials.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering (full box) for storage and identified with labels describing contents.
   1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.9 QUALITY ASSURANCE

A. Manufacturers Qualifications: Carpet tile product manufacturer will have a technical installation representative available at the job site at the inception of the installation to insure there are not conditions which will compromise the installation of the material and that the material is being installed according to industry standards, practices and manufacturers guidelines. The manufacturer's technical representative will document and confirm that the substrate, material, and installation are in compliance with manufacturer's guidelines and accepted industry standards and practices.
   1. Any noticed defect with the product or installation system will require the response of the manufacturer's technical field service personnel on-site to determine cause, correction or replacement.

B. Mockups: Build mockups to verify selections to demonstrate aesthetic effects, and to set quality standards for installation method including orientation of the carpet tile.
   1. First-in-Place: 100 sq.ft. shall serve as mockup.
   2. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 5, "Storage and Handling."
   1. Storage: Store carpet and related materials in a climate-controlled, dry space. Protect carpet from soil, dust, moisture and other contaminants and store on a flat surface.

B. Carpet shall be delivered to the jobsite in the original mill wrappings with each roll having its size, dye lot, material, and register number properly marked on each bale. When delivered to the jobsite, deliver register number tags to the A/E along with a sample of each carpet cut from the roll.

C. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or set aside for Owner to use as extra materials.
   2. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.
   3. Fold up metal banding, flatten, and place in designated area for recycling.

D. Indoor Air Quality
   1. Temporary Ventilation
      a. Ventilate products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant source and residues. Provide a temperature range of 60 deg F minimum to 90 deg F maximum continuously for minimum 72 hours. Do not ventilate within limits of work, if at all possible.

1.11 FIELD CONDITIONS

A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.12 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.
   3. Warranty Period: Non-prorated Lifetime Limited warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.
   1. Refer to “List of Finishes.”

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.
   1. Where products are indicated on List of Finishes with colors selected, provide sample to verify color match with substitution request.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated, as determined by testing identical products per ASTM E 648 and NFPA 253 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Critical Radiant Flux Classification: Not less than 0.45 W/sq.cm.
   2. Flooring Radiant Panel Test: Meets NFPA Class 1 when tested under ASTM E-648 glue down.
   3. Smoke Density: NBS Smoke Chamber NFPA-258, less than 450 flaming mode.

B. Chemical Emission/Indoor Air Quality: Carpet shall comply with the Carpet and Rug Institute (CRI) Green Label Plus Program. The program label and registration number serve as evidence of compliance.

C. Accessibility: Flooring shall be provided to comply with accessibility requirements of the U.S. Architectural and Transportation Barriers Compliance Board’s ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1 as required by local authorities with jurisdiction.

2.3 CARPET TILE (CART)

A. General: Refer to “List of Finishes”.
   1. Note: Where indicated utilize Owner’s attic stock to patch existing as required to accommodate new work.

2.4 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer. Material must be compatible and coordinated with concrete slab mix.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and high-moisture subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
   1. Adhesives shall be approved by manufacturer for use over concrete substrates with maximum RH of less than 95 percent (ASTM F2170) and maximum pH of 10 and adhesive shall be compatible with flooring material backing and suitable for substrate conditions.
   2. Where results of relative moisture testing of concrete per ASTM F 2170 exceed 95percent relative humidity moisture level work to remedy will be by change order. Contractor shall propose a solution as recommended by flooring manufacture.
   3. Adhesives shall comply with testing and product requirements of California Department of Health Services' *Standard Practice for Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers*, including 2004 Addenda.
      a. Alternatively, adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Metal Edge/Transition Strips: Extended aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

2.5 SOURCE QUALITY CONTROL

A. Manufacturer Services: Manufacturer assures product submitted is appropriate for application and environment in which it is to be installed and that product is merchantable for service, free of visible and latent defects and will perform for purpose for which it is intended without compromise.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and following:
   1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
      a. Moisture testing shall be performed at least 60 days in advance of flooring installation to allow sufficient drying time if levels are found to be excessive.
         1) If moisture levels in concrete slabs are too high, temporary climate control may be used to remove excess moisture to levels acceptable to floor manufacturer. Refer to Division 01 Section “Temporary Facilities and Controls.”
   2. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a less than 95 percent relative humidity level measurement.

3. Substrate shall exhibit a pH in range of 5 to 10 when wetted with potable water and tested by applying test paper.
4. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
5. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
6. Substrate Density: Assess substrate density for absorptivity/porosity per ASTM F3191-16.

D. Verify substrate mix design for additives, i.e. hardeners, moisture vapor reduction admixture and other ingredients that might affect performance of installed flooring.
1. If concrete additives, i.e., hardeners, moisture vapor reduction admixtures or other ingredients have been included in mix or suspected to be in mix that might affect performance of flooring installation, test bond.
a. Perform bond and any additional tests as recommended by flooring manufacturer. If tests do not produce satisfactory results, coordinate with both concrete additive manufacturer and flooring manufacturer for potential solutions. Retest until a satisfactory result can be obtained.

E. Proceed with installation only after unsatisfactory conditions have been corrected and manufacturer has approved substrate for material to be installed without compromise.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
1. During installation, maintain air circulation by operating HVAC system at full capacity.
2. Continue operating ventilation system at normal room temperature for up to 72 hours after installation.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive, in accordance with recommended written installation instructions by manufacturer.
1. Product as installed to be securely attached to floor in compliance with Americans with Disabilities Act (ADA), Section 4.5.3.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Maintain pile direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
   1. Joints: Modules in complete installation should be tight, but not compressed. To insure proper spacing when installing modular carpet, measure distance covered by 11 modules (10 joints) installed on floor with no visible gaps, peaks or overlaps. Continually check that modules are being installed in compliance with manufacturer specifications for that particular product. Take care not to trap yarn between modules.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform following operations immediately after installing carpet tile:
   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
   2. Remove yarns that protrude from carpet tile surface.
   3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

SECTION 09 84 53 – SOUND BARRIER MULLION TRIM CAP

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sound barrier mullion trim caps providing sound transmission control at storefront and curtain wall assemblies.

B. Related Requirements:
1. Division 07 Section “Joint Sealants” for joint sealing.
2. Division 08 Section “Aluminum-Framed Storefront” for storefront construction.
3. Division 09 Section “Gypsum Board Assemblies” for interior wall construction.

1.2 ACTION SUBMITTALS

A. Product Data
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sound barrier wall end cap system.

B. Shop Drawings:
1. Include typical dimensional cross-section(s) at the location where drywall partition terminates at the perimeter curtain wall, indicating:
a. Dimensions
b. Finish

C. Samples: For each exposed product and for each color and texture specified.
1. Size: 12 inches.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Qualification Data: For installer.

B. Product Test Reports: For each sound barrier mullion trim cap assembly, for ASTM E90 tests performed by a qualified third party testing agency.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: ASTM E 90 testing to be performed by laboratory accredited by IAS as complying with ISO/IEC Standard 17025.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver sound barrier mullion trim caps until spaces to receive them are clean, dry, and ready for their installation.

B. Store sound barrier mullion trim caps in original undamaged packaging inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

C. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.
2. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.

3. Fold up metal banding, flatten, and place in designated area for recycling.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace sound barrier mullion trim caps that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Ten years limited warranty from date of Substantial Completion.
   2. Limited warranty does not cover adjacent products or improper installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide Mull-it-Over Products; sound barrier mullion trim cap system, www.mullitoverproducts.com or comparable product by one of the following:
   1. Mullion Mate; Gordon Inc.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for Architect/Engineer's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 SYSTEM DESCRIPTION

A. General: Provide sound barrier mullion trim caps of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
   1. Furnish units in lengths of sufficient additional length to allow for field trimming to required length to match variations in construction tolerances of adjacent systems.

2.3 PERFORMANCE REQUIREMENTS

A. Sound Transmission
   1. Single Sided Installations: STC 51 or better.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Mullion trim cap to be sized to accommodate thermal movement.

2.4 SOUND BARRIER MULLION TRIM CAP

A. Sound Barrier Mullion Trim Cap
   1. Products: MULL-it-OVER Products; Mullion Trim Cap.

B. Profile: 57 Classic Mullion Trim Cap.

2.5 COMPONENTS

A. Aluminum Extrusions
   1. Thickness: 0.125 inches.
   2. Profile: As selected and approved by A/E to allow solid attachment and fastening to the partition wall framing.

B. Sound Absorbing Foam
   1. Resistant to smoke, flame, and microbial growth.

2. Fire Rating: ASTM E 84 Class 1.
3. Fungi Resistance: Zero rating per ASTM G21.

C. Compressible Foam: Between edge of extrusion and interior face of curtain wall glass.
1. Thickness: Standard 5/16 inch, compressible to 1/4 inch, or larger thickness to accommodate a larger mullion deflection.

D. Fasteners
1. Self tapping or appropriate threaded fastener.
2. Compatible with all materials fasteners will contact with and not causing galvanic corrosion.

E. Snap Cover: Snap-on fastener cover.

F. Acoustical Sound Sealant: Acrylic latex based.

2.6 ACCESSORIES

A. Provide necessary and related parts and tools to complete installation.

2.7 FABRICATION

A. Extrusions and generic profiles to be shipped in custom lengths as required to meet project requirements for shipped in standard incremental foot lengths and cut to exact length on jobsite.

2.8 FINISHES

A. Exposed surfaces of exposed aluminum extrusion.
1. Standard Finish: Supplied in clear anodized finish.
2. Custom Finish: Custon anodized finishes and painted finishes available upon request.

B. Finishes
1. Aluminum – clear anodize
a. Clear anodized finsih in accordance with AA-M10 C22 A41 Class I (0.7 to 1.0 thick anodic coating).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls and adjacent curtain wall for suitable conditions where sound barrier wall end cap will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Measure and cut sound barrier wall end cap to proper lengths.

B. Notch around horizontal mullions, sills, or other obstructions leaving appropriate gap for differential movement between the sound barrier wall end cap and the obstruction.

C. Apply continuous bead of acoustical sealant to the acoustical foam surface that will be in contact with the drywall edge.

D. Place sound barrier wall end cap on the vertical surface of the drywall partition wall and loosely install fasteners in the top and bottom slotted holes of the wall end caps.

E. Plumb the wall end cap leaving recommended gap spacing of a minimum 5/16 inch between the interior glass surface and the aluminum return leg of the wall end caps. The closed cell foam gasket material will be in contact with the glass surface allowing for differential movement between the mullion cap and the curtain wall. Increase the gap spacing if recommended by the engineer or record of curtain wall manufacturer.

F. Tighten top and bottom fasteners to secure end cap.

G. Install additional fasteners at 12 inches on center, minimum.

H. Install snap cover to conceal fasteners.

I. Apply sealant at joints of dissimilar materials as desired.

3.3 CLEANING

A. After work is complete in adjacent areas, clean exposed surfaces with suitable cleaner that will not harm or attach the finish.

3.4 PROTECTION

A. Protect sound barrier wall end caps from damage during installation, general construction activities, and until turnover of structure.

END OF SECTION 09 84 53

SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
   1. Steel and iron.
   2. Galvanized metal.

B. Work under this contract shall also include, but not necessarily be limited to the following:
   1. Surface preparation of substrates as required for acceptance of painting, including cleaning, small crack repair, patching, and caulking.
      a. Preparation and testing of existing painted surfaces, indicated to be repainted to accommodate new work, shall be pre-formed as work of this Section.
   2. Priming (except where pre-primed with an approved primer under other sections of work) and painting of structural steel, miscellaneous metal, and primed steel equipment.
   3. Painting of all semi-concealed areas (e.g. inside of light troughs and valances, behind grilles, and projecting edges above and below sight lines).
   4. Painting of roof vent flashings.
   5. Painting of exposed to view fire suppression, plumbing, HVAC, electrical, communication, and electronic safety and security work unless prefinished.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
   1. Finished metal surfaces include the following:
      a. Anodized aluminum
      b. Stainless steel
      c. Copper and copper alloys
      d. Bronze and brass
   2. Operating parts include moving parts of operating equipment.
   3. Labels: Do not paint over UL, FM Global, or other code required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Remodeling Work: Where it is necessary to patch and match existing surfaces, prepare surfaces as specified under "Surface Preparation" of this Specification Section. Apply finish paint coats to entire surface adjacent to patched work, terminating paint application at nearest change in surface plane or as directed by A/E.
   1. Where required, remove existing wall covering and prepare existing substrate as necessary (sand, prime, and clean) to receive new finish material. Prepare existing painted surfaces to receive painted finish; new paint finish to be applied over properly prepared existing paint finish may be a 2-coat system, eliminating the initial prime coat.

E. Related Sections include the following:
   1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
   2. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.2 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
   1. Flat refers to a lusterless or matte finish with a glass range below 15 when measured at an 85-degree meter.
   2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
   3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including primers and the following:
   1. Product characteristics.
   2. Surface preparation instructions and recommendations.
   3. Primer requirements and finish specification.
   4. Storage and handling requirements and recommendations.
   5. Application methods.
   6. VOC content.

B. Samples for Initial Selection: For each type of topcoat product, where color is not preselected.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
   1. Submit Samples on rigid backing, 8 inches square.
   2. Step coats on Samples to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product List: For each product indicated, include the following:
   1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

B. Test Reports: Site testing utilized to confirm satisfactory adhesion of the intended coating or coating system prior to final coating application, when repainting over existing finishes.

1.5 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. At project completion provide an itemized list complete with manufacturer, paint type and color coding of all paints used for Owner’s later use in maintenance.
   2. Receipt of extra materials.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Color name and number.
   8. VOC content.

B. Store Materials
   1. Store only the approved materials at the Project site and store only in a suitable and designated area restricted to the storage of paint materials and related equipment.
      a. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
      b. Protect from freezing. Keep storage area neat and orderly.
      c. Remove oily rags and waste daily.

2. Use means necessary to ensure the safe storage and use of paint materials and the prompt and safe disposal of waste.
3. Use means necessary to protect paint materials before, during, and after application and to protect the installed work and materials of other trades.
4. Where toxic and/or volatile/explosive/flammable materials are being used, provide adequate fireproof storage lockers and take all necessary precautions and post adequate warnings (e.g. no smoking) as required.
5. Take all necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect the environment from hazard spills. Materials that constitute a fire hazard (paints, solvents, drop clothes, etc.) shall be stored in suitable closed and rated containers and removed from site on a daily basis.

C. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or set aside extra paint for reuse by Owner.
2. Close and tightly seal all partly used paint and finish containers and store protected in well ventilated, fire-safe area at moderate temperature.
3. Place empty containers of solvent-based paints in areas designated for hazardous materials.
4. Do not dispose of paints or solvents by pouring on the ground. Place in designated containers for proper disposal.
5. To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground the following procedures shall be strictly adhered to:
    a. Retain cleaning water for water-based materials to allow sediments to be filtered out. In no case shall equipment be cleaned using free draining water.
    b. Retain cleaners, thinners, solvents, and excess paint and place in designated containers and ensure proper disposal.
    c. Return solvent- and oil-soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
    d. Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.
    e. Empty paint cans are to be dry prior or disposal or recycling (where available).
    f. Close and seal tightly partly used cans of materials including sealant and adhesive containers and store protected in well-ventilated fire-safe area at moderate temperature.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
1. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 degrees F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

C. Perform no exterior painting work unless environmental conditions satisfy written requirements of paint manufacturer or until adequate weather protection is provided. Where required, suitable weatherproof covering and sufficient heating facilities shall be in place to maintain minimum ambient air and substrate temperatures for 24 hours before, during and after paint application.

D. Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

1.8 SCHEDULING

A. Schedule painting operations at occupied facilities to prevent disruption of occupants in and about the building. Painting shall be carried out after facility working hours and weekends in accordance with Owner's operating requirements, where work cannot be sectioned off. Schedule work such that painted surfaces will have dried before occupants are affected. Obtain written authorization from Owner for changes in work schedule once established.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
   1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers as listed hereinafter.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The "Substitution Request Form" and complete technical data for evaluation must accompany requests for A/E's approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PAINT, GENERAL

A. Material Compatibility: Paint materials selected for coating systems for each type of surface shall be the product of a single manufacturer.
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Thinners, when used, shall be only those thinners recommended for that purpose by the manufacturer of the material to be thinned.

C. All materials used shall be lead-, mercury-, and cadmium free and shall have a VOC content not exceeding the following, unless a lower VOC content is required by authorities having jurisdiction.

D. Colors: As indicated in "List of Finishes".

E. Submission of a proposal indicates that the Contractor has reviewed the bidding documents with the painting subcontractor and accepts the Specifications as sufficient to produce approved painting results. If the painting subcontractor contends that the materials or number of coats specified will not produce satisfactory results, he shall so notify the A/E directly or indirectly through a Bidding Contractor 10 days prior to receipt of bids for proper action.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
   1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. Remove and securely store (e.g. electrical plates, door hardware)., removable rating/hazard/instruction labels, light fixture trim, etc. from wall and ceiling surfaces, doors and frames, prior to painting, and replace upon completion. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. Carefully clean and replace all such items upon completion of painting work in each area. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (e.g. lacquer finishes).
   2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
   3. Hollow metal doors shall be removed before repainting to paint bottom and top edges and then re-hung.
   4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or provide barrier coats as required to produce paint systems indicated. Notify A/E in writing about anticipated problems using the specified finish coat materials with substrates primed by others.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
   1. SSPC-SP 2, "Hand Tool Cleaning," unless otherwise recommended by paint manufacturer for substrate indicated.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
   1. Surface preparation should start with SSPC SP-1 Solvent Cleaning to remove oil/grease contamination. If the galvanized surface is shinney, the surface must be de-glossed and roughened in one of two ways:

2. Galvanized metals are very smooth and have virtually no profile for the coating to adhere to. It is important to abrade the surface of the galvanized metal through Brush of Blast (SSPC SP7), or an etching primer before coatings application, as recommended by paint manufacturer.
3. Galvanized surfaces must use a primer before applying a topcoat. Topcoats will not adhere to the zinc layer of the galvanized surface and requires a primer to form a bond between the two. Manufacturer's water-based bonding primers as an alternative to the previously used cementitious primers. An epoxy primer may also be used, however, it should be noted that epoxy primers typically require an abrasive blast-cleaned surface.

G. Existing Painted Surfaces
1. In accordance with good painting practice, all surface and absorbed contaminants (i.e., dirt, dust, grease, oil, mildew, moisture, chemical fall-out, etc.) shall be removed prior to applying any new coat of paint, since performance and adhesion of the new coat is directly proportional to the cleanliness of the substrate.
2. Removal of old painting system prior to the application of a new coat of paint shall not be required unless adhesion problems between the existing coating and new proposed coating cannot be eliminated.
   a. New coating shall be compatible with existing coating based on previous testing of coating products for adhesion by manufacturer and on installer's field experience.
   b. A test patch shall be used when previous testing does not exist or is unacceptable to A/E. Refer to article entitled "Field Quality Control" below.
   c. The preparation of substrates does not apply to previously coated surfaces that contain lead. These surfaces require special preparation. Contractor shall refer to recommendations of paint manufacturer for preparation requirements.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.
1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Do not paint over labels of independent testing agencies of equipment name, identification, performance rating, or nomenclature plates.
4. Primers specified in paint schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Scheduling Painting: Apply first coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
2. Slightly vary the color of succeeding coats.

C. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate.
1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
2. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn through or other defects due to insufficient sealing.

D. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

E. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

F. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

G. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
   1. Paint the following where exposed to view:
      a. Equipment, including panel boards.
      b. Uninsulated metal piping.
      c. Pipe hangers and supports.
      d. Metal conduit.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
   1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
   2. Testing agency will perform tests for compliance of paint materials with product requirements, including dry film thicknesses.
      a. Contractor shall touch up and restore painted surfaces damaged by testing.
      b. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.
   3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
   1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminates from entering into waterways, sanitary and storm drain systems, and ground.
   2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
   3. Allow empty cans to dry before disposal.
   4. Collect waste paint cans to dry before disposal.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by A/E, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE (P-Code)

A. Steel and Iron (Ferrous) Substrates:
   1. W.B. Light Industrial Coating System: (Code #5.1)
      a. Prime Coat: Primer, Rust-Inhibitive, Water-Based.

1) Sherwin Williams; Pro-Industrial Pro-Cryl Universal Primer
2) PPG; 4020 Pitt-Tech Plus DTM Industrial Primer
3) Benjamin Moore: Super Spec HP Metal Primer, P04.
4) Behr Metal Primer No. 435

b. Intermediate Coat: Light industrial coating, exterior matching topcoat.

c. Topcoat: Light industrial coating, exterior (semigloss).
1) Sherwin Williams; B66-600 Pro Industrial Acrylic
2) PPG; 4216HP Pitt-Tech Plus DTM
3) Benjamin Moore Ultra Spec HP DTM Acrylic Semi-Gloss HP29
4) Behr Premium Direct-To-Metal Semi-Gloss No. 3200
5) Applications: Include, but are not limited to:
a) Structural steel and metal fabrications.
b) Exposed to view fire suppression, plumbing, HVAC, electrical, communication and electronic safety and security work unless prefinished.

B. Steel-High Heat Substrates:
1. Heat Resistant Enamel System: (Code #5.2)
a. Prime Coat:
1) Sherwin Williams: Flame Control, TemperKote 1000
2) PPG: Hi-Temp 1027
3) Dampney: Thurmalox 210C

b. Topcoat: Heat resistant enamel finish (semi-gloss)
1) Sherwin Williams: Flame Control, TemperKote 600
2) PPG: Hi-Temp 500 VS
3) Dampney: Thurmalox 200C
4) Application: Include, but are not limited to:
a) Heat exchangers, breeching, pipes, flues, stacks, etc., with temperature range of up to 400 deg. F.

C. Galvanized-Metal (Non-Ferrous) Substrates:
1. Water-Based Light Industrial Coating System: (Code #5.3).
a. Prime Coat: Primer, galvanized, water based, or topcoat manufacturer's recommended primer for indicated application.
1) Sherwin Williams; Pro-Industrial Pro-Cryl Universal Primer
2) PPG; 4020 Pitt-Tech Plus DTM Industrial Primer
3) Benjamin Moore; Ultra Spec HP Acrylic Metal Primer HP04
4) Behr Multi-Surface Stain-Blocking #436
5) Note: Prime coat may be omitted when not required by paint manufacturer.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

c. Topcoat: Light industrial coating, exterior, water based (semigloss).
1) Sherwin Williams: B66-600 Pro Industrial Acrylic
2) PPG: 4216HP Pitt-Tech Plus DTM
3) Benjamin Moore Ultra Spec HP DTM Acrylic Semi-Gloss HP29
4) Behr Premium Direct-to-Metal Semi-Gloss No. 3200
5) Applications: Include, but are not limited to:
a) Exterior lintels.
b) Miscellaneous exposed metal items, including exposed to view fire suppression, plumbing, HVAC, electrical, communication and electronic safety and security work, unless prefinished.
c) Exterior pipe and tube railings.

END OF SECTION 09 91 13

SECTION 09 91 23.00 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and application of paint systems on the following interior substrates:
   1. Clay masonry (Existing, where indicated).
   2. Concrete masonry units (CMU).
   3. Steel and iron.
   4. Galvanized metal.
   5. Gypsum board.
   6. Cotton or canvas insulation covering.
   7. ASJ insulation covering.

B. Work under this contract shall also include, but not necessarily be limited to following:
   1. Surface preparation of substrates as required for acceptance of painting, including cleaning, small crack repair, patching, and caulking.
      a. Preparation and testing of existing painted surfaces, indicated to be repainted to accommodate new work, shall be performed as work of this Section.
         1) When re-painting existing surfaces, “making good surfaces” includes removal of adhesive tape, hanging devices, nails, screws, and similar items, and repair of associated surface defects to match adjoining surface.
      b. Provide for safe and adequate ventilation as required over and above temporary ventilation supplied by others, where toxic and/or volatile/flammable materials are being used.
   2. Priming (except where pre-primed with an approved primer under other sections of work) and painting of structural steel, miscellaneous metal, and primed steel equipment.
   3. Painting of all semi-concealed areas (e.g. inside of light troughs and valances, behind grilles, and projecting edges above and below sight lines).
   4. Painting of exposed-to-view fire suppression, plumbing, HVAC, electrical, communication, and electronic safety and security.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
   1. Concealed surfaces including walls or ceilings in following generally inaccessible spaces:
      a. Foundation spaces
      b. Furred areas
      c. Ceiling plenums
      d. Utility tunnels
      e. Pipe spaces
      f. Duct shafts, unless otherwise noted
      g. Elevator shafts
   2. Finished metal surfaces include following:
      a. Anodized aluminum
      b. Stainless steel
      c. Chromium plate
      d. Copper and copper alloys
      e. Bronze and brass
   3. Operating parts include moving parts of operating equipment.
      a. Valve and damper operators (including valve stems).
      b. Linkages
      c. Sensing devices
      d. Motor and fan shafts
   4. Labels: Do not paint over UL, FMG, or other code required labels or equipment name, identification, performance rating, or nomenclature plates.

5. Communication Cable: Do not paint cable and protect communications cabling from overspray. Paint voids warranty of cable and if painted shall be replaced at painting contractors expense.
    a. Communications plenum cable.
    b. Communications riser cable.
    c. Communications general purpose cable.
    d. Communications cable, limited use.
    e. Under carpet communications wire and cable.

D. Remodeling Work: Where it is necessary to patch and match existing surfaces, prepare surfaces as specified under "Surface Preparation" of this Specification Section. Apply finish paint coats to entire surface adjacent to patched work, terminating paint application at nearest change in surface plane or as directed by A/E.
1. Where required, remove existing wall covering and prepare existing substrate as necessary (sand, prime, and clean) to receive new finish material. Prepare existing painted surfaces to receive painted finish; new paint finish to be applied over properly prepared existing paint finish may be a 2-coat system, eliminating initial prime coat.
2. When repainting occupied areas, submit work schedule for various stages of work for A/E's and Owner's review.

E. Related Sections include following:
1. Division 05 Sections for shop priming of metal substrates.
2. Division 08 Sections for factory priming hollow metal frames with primers specified in this Section.
3. Division 09 Section "Gypsum Board Assemblies" for finishes and repairs.
4. Division 09 Section "Exterior Painting" for surface preparation and application of paint systems on exterior substrates.

1.2 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
1. Flat refers to a lusterless or matte finish with a glass range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter. .
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for application and use.

B. Samples for Initial Selection: For each type of topcoat product, where color has not been preselected.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product List: For each product indicated, include following:
   1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

B. Test Reports: Site testing utilized to confirm satisfactory adhesion of intended coating or coating system prior to final coating application.

C. Submit invoice list of all paint materials ordered for Project work indicating manufacturer, types and qualities for verification and compliance with specification.

1.5 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Receipt of extra materials. Properly package materials and obtain a signed receipt.
   2. At Project completion provide an itemized list complete with manufacturer, paint type and color coding of all paints used for Owner's later use in maintenance.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements
   1. Conform to workplace safety regulations for storage, mixing, application and disposal of all paint related materials to requirements of those authorities having jurisdiction.
   2. To reduce amount of contaminants entering waterways, sanitary/storm drain systems or into ground following procedures shall be strictly adhered to:
      a. Retain cleaning water for water-based materials to allow sediments.
      b. Retain cleaners, thinners, solvents, and excess paint and place in designated containers and ensure proper disposal.
      c. Return solvent and oil-soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
      d. Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.
      e. Empty paint cans are to be dry prior to disposal or recycling.
      f. Close and seal tightly partly used cans of materials including sealant and adhesive containers and store protected in well-ventilated fire-safe area at moderate temperature.

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Surface-Preparation Mockups: On existing surfaces using applicable methods recommended by paint manufacturer demonstrate methods of cleaning and other surface preparation, where indicated by A/E. Provide mockup sample of at least 100 sq.ft. for each type of wall substrate.
   2. A/E will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
      a. Wall and ceiling surfaces, unless otherwise noted, first-in-place 100 sq.ft. of each product and surface may serve as mockup.
         1) Provide a test patch where deep colors are indicated.
      b. Other Items: A/E will designate items or areas required.
   3. Apply benchmark samples after permanent lighting and other environmental services have been activated.
   4. Final approval of color selections will be based on benchmark samples.
      a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by A/E at no added cost to Owner.

5. Approval of mockups does not constitute approval of deviations from Contract Documents contained in mockups unless A/E specifically approves such deviations in writing.
6. Subject to compliance with requirements, approved mockups may become part of completed work if undisturbed at time of Substantial Completion.

C. Preinstallation Meeting: Conduct meeting at Project site.
1. Review methods and procedures related to painting, including recoating of existing surfaces, but not limited to, following:
   a. Construction Schedule. Verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Materials, material application, colors, patterns, and sequencing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to job site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and following information:
1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store Materials
1. Store only approved materials at jobsite and store only in a suitable and designated area restricted to storage of paint materials and related equipment.
   a. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   b. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.
   c. Remove rags and waste from storage areas daily.
2. Use means necessary to ensure safe storage and use of paint materials and prompt and safe disposal of waste.
3. Use means necessary to protect paint materials before, during, and after application and to protect installed work and materials of other trades.
4. Where toxic and/or volatile/explosive/flammable materials are being used, provide adequate fireproof storage lockers and take all necessary precautions and post adequate warnings as required.
5. Take all necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect environment from hazard spills. Materials that constitute a fire hazard (paints, solvents, drop clothes, etc.) shall be stored in suitable closed and rated containers and removed from site on a daily basis.

C. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product or set aside extra paint for reuse by Owner.
2. Close and tightly seal all partly used paint and finish containers and store protected in well-ventilated, fire-safe area at moderate temperature.
3. Place empty containers of solvent-based paints in areas designated for hazardous materials.
4. Do not dispose of paints or solvents by pouring on ground. Place in designated containers for proper disposal.

5. To reduce amount of contaminants entering waterways, sanitary/storm drain systems or into ground following procedures shall be strictly adhered to:
    a. Retain cleaning water for water-based materials to allow sediments to be filtered out. In no case shall equipment be cleaned using free draining water.
    b. Retain cleaners, thinners, solvents, and excess paint and place in designated containers and ensure proper disposal.
    c. Return solvent and oil-soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
    d. Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.
    e. Empty paint cans are to be dry prior or disposal or recycling (where available).
    f. Close and seal tightly partly used cans of materials including sealant and adhesive containers and store protected in well-ventilated fire-safe area at moderate temperature.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
    1. Apply solvent thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F. and 95 degrees F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above dew point; or to damp or wet surfaces.

C. Perform no interior painting or decorating work unless adequate continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above minimum requirements for 24 hours before, during, and after paint application. Provide supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

D. Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect quality of finished surfaces.

E. Perform no painting or decorating work unless a minimum lighting level of 30 foot candles is provided on surfaces to be painted.

1.9 SCHEDULING

A. Schedule painting operations in occupied facilities to prevent disruption of occupants in and about building. Paint shall be carried out after facility working hours or on weekends in accordance with Owner's operating requirements. Schedule work such that painted surfaces will have dried before occupants are affected. Obtain written authorization from Owner for changes in work schedule.

1.10 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied in unopened cans and that are packaged for storage and identified with labels describing contents for Owner's later use in maintenance. Store where directed.
    1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of manufacturers as indicated hereinafter.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed material requirements and functional qualities of specified product. “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PAINT, GENERAL

A. Material Compatibility: Paint materials selected for coating systems for each type of surface shall be product of a single manufacturer.
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Paint materials and equipment shall be compatible in use; finish coats shall be compatible with prime coats; prime coats shall be compatible with surface to be coated; tools and equipment shall be compatible with coating to be applied.
   1. Review other Sections in which primers are provided to ensure compatibility of total system for various substrates. On request, furnish information on characteristic of finish materials to ensure use of compatible primers.

C. Thinners, when used, shall be only those thinners recommended for that purpose by manufacturer of material to be thinned.

D. All materials used shall be lead-, mercury-, and cadmium free and VOC-compliant with local authorities with jurisdiction.

E. Low-Emitting Materials: Interior paints and coatings shall comply with testing and product requirements of California Department of Health Services' "Standard Practice for Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Colors: As indicated in “List of Finishes.”

G. By submitting a proposal, Contractor has reviewed bidding documents with painting subcontractor and accepts Specifications as sufficient to produce approved painting results. If painting subcontractor contends that materials or number of coats specified will not produce satisfactory results, he shall so notify A/E directly or indirectly through a Bidding Contractor 10 days prior to receipt of bids for proper action.

2.3 MIXING AND TINTING

A. Unless otherwise specified or pre-approved, all paints shall be ready mixed and pre-tinted. Re-mix all paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and color and gloss uniformity.

B. Paste, powder, or catalyzed paint mixes shall be mixed in strict accordance with manufacturer’s written instructions.

C. Where thinner is used, addition shall not exceed paint manufacturer's recommendations.

D. If required, thin paint for spraying in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to A/E.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Test suspect surfaces (masonry surfaces) for moisture and alkalinity as required by paint manufacturer. Conduct all moisture tests using a properly calibrated electronic moisture meter, unless otherwise required by paint manufacturer. Maximum moisture shall not exceed:
   1. Masonry (Clay and CMU): 12 percent
   2. Gypsum Board: 12 percent

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
   1. Test galvanized surfaces for chromates or other passivating treatments.

E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
   1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates indicated.
   1. Proper product selection, surface preparation and application affect coating performance. Coating integrity and service life will be reduced because of improperly prepared surfaces. Selection and implementation of proper surface preparation ensures coating adhesion to substrate and prolongs service life of coating system.

B. Remove and securely store all miscellaneous hardware and surface fittings/fastenings (e.g. electrical plates, mechanical louvers, door and window hardware) (e.g. hinges, knobs, locks, trim frame stops), removable rating/hazard/instruction labels, washroom accessories, light fixture trim, etc. from wall and ceiling surfaces, door and frames, prior to repainting and replace upon completion. Carefully clean and replace all such items upon completion of repainting work in each area. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (e.g. lacquer finishes). Doors shall be removed before repainting to paint bottom and top edges and then re-hung. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Protect all adjacent interior surfaces and areas, including rating and instruction labels on doors, frames, equipment, piping, etc., from painting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.
   1. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, nomenclature plates, or communicating cabling.

D. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
   1. Schedule cleaning and painting application so dust and other contaminates from cleaning process will not fall on wet, newly coated surfaces.
   2. Remove incompatible primers and reprime substrate with compatible primers or provide barrier coats as required to produce paint systems indicated. Notify A/E in writing about anticipated problems using specified finish coats materials with substrates primed by others.

E. Clay Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content of surfaces or alkalinity of mortar joints to be painted exceed that permitted in manufacturer's written instructions.

F. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

G. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer, but not less than following:
   1. SSPC-SP 2, "Hand Tool Cleaning," unless otherwise noted or recommended by paint manufacturer for application indicated.

H. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

I. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
   1. Surface preparation should start with SSPC SP-1 Solvent Cleaning to remove oil/grease contamination. If galvanized surface is shinney, surface must be de-glossed and roughened in one of two ways:
      a. In mild building environments, wash with a chemical etching solution.
   2. Galvanized metals are very smooth and have virtually no profile for coating to adhere to. It is important to abrade surface of galvanized metal through Brush of Blast (SSPC SP7), or an etching primer before coatings application, as recommended by paint manufacturer.
   3. Galvanized surfaces must use a primer before applying a topcoat. Topcoats will not adhere to zinc layer of galvanized surface and requires a primer to form a bond between two. Manufacturer’s water-based bonding primers as an alternative to previously used cementitious primers. An epoxy primer may also be used, however, it should be noted that epoxy primers typically require an abrasive blast-cleaned surface.

J. Gypsum Wallboard: Must be clean and dry. Fill nail heads must be set and spackled. Joints must be taped and covered with joint compound. Spackled nail heads and taped joints must be sanded smooth and all dust removed prior to painting.
   1. Vacuum wall with brush attachment.
      a. As wall is vacuumed, wipe if down with microfiber cloth. Piles of dust may accumulate near base. Be sure to vacuum this dust before you begin to paint; otherwise, it could become airborne and ruin your smoothly painted wall.
   2. Wipe down wall with microfiber cloth.
   3. Gently wash walls.
      a. Apply water sparingly. Let wall dry thoroughly before painting.
   4. Repeat steps until all traces of dust are removed.

K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

L. Existing Painted Surfaces: Prepare all interior surfaces for repainting in accordance with paint manufacturers requirements.

1. In accordance with good painting practice, all surface and absorbed contaminants (i.e., dirt, dust, grease, oil, mildew, moisture, chemical fall-out, etc.) shall be removed prior to applying any new coat of paint, since performance and adhesion of new coat is directly proportional to cleanliness of substrate.
2. Removal of old painting system prior to application of a new coat of paint shall not be required unless adhesion problems between existing coating and new proposed coating cannot be eliminated.
    a. New coating shall be compatible with existing coating based on previous testing of coating products for adhesion by manufacturer and on installer's field experience.
    b. A test patch shall be used when previous testing does not exist or is unacceptable to A/E.
    c. Preparation of substrates does not apply to previously coated surfaces that contain lead. These surfaces require special preparation. Contractor shall refer to recommendations of paint manufacturer for preparation requirements.

3.3 APPLICATION

A. General: Do not commence painting unless substrates are acceptable and until all environmental conditions (heating, ventilation, lighting and completion of other substrate work, if applicable) are acceptable for applications of products.

B. Apply paints according to manufacturer's written instructions.
1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
5. Omit first coat (primer) on metal surfaces that have been shop primed and touch-up painted, unless otherwise indicated.
6. Where a level 5 drywall finish is specified or required in critical lighting conditions or when using non-flat finish, comply with following to optimize results:
    a. Even if initial finish was sprayed, back roll surface: Stipple pattern of roller can help hide underlying texture variations. A 1/2 inch/15 mm nap roller may offer best and most efficient results.
    b. When finish occurs in phases (stops one batch and finishes with another) painter shall "blend back" finish of each new section by shading new topcoat back over previous section with a spray gun; with a flat finish, this can effectively prevent a noticeable difference between sections finished at different dates with material from different batches.

C. Scheduling Painting: Apply first coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of undercoat, unless manufacturer's directions state otherwise, each coat shall be sufficiently dry and hard before a following coat is applied.
2. Slightly vary color of succeeding coats.

D. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate.
1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
2. Sand and dust between each coat to provide an anchor for next coat and to remove defects in preview coat (runs, sags, etc.) visible from a distance up to 39 inches.

3. Deep and accent clear base colors may require 1 or 2 more coats to achieve proper hide.

E. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

F. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
1. To avoid air entrapment in applied coats, apply material in strict accordance with manufacturer's spread rates and application requirements.

G. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication and Electronic Safety and Security Work:
1. Paint following work where exposed in occupied spaces:
a. Mechanical, electrical, and other equipment:
1) Exceptions:
a) Do not paint electrical switchgear, transformers or substation equipment.
b) Do not paint new electrical panelboards.
c) Do not paint communication cabling.
d) Do not paint sprinkler heads.
b. Uninsulated metal piping.
c. Pipe hangers and supports.
d. Metal conduit.
e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
2. Paint portions of internal surfaces of metal ducts, without liner behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves right to invoke following procedure at any time and as often as Owner deems necessary during period when paints are being applied:
1. Owner will engage services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements, including dry film thicknesses.
a. Contractor shall touch up and restore painted surfaces damaged by testing.
b. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, two paints are incompatible.

B. Standard of Acceptance
1. All surfaces, preparation and paint applications shall be inspected by A/E.
2. Painted interior surfaces shall be considered to lack uniformity and soundness if any of following defects are apparent to A/E:
a. Brush/roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.

b. Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
c. Damage due to touching before paint is sufficiently dry or any other contributory cause.
d. Damage due to application on moist surfaces or caused by inadequate protection from weather.
e. Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).

3. Painted surfaces shall be considered unacceptable if any of following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces:
a. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 39 inches.
b. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 39 inches.
c. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
d. When final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.

4. Painted surfaces rejected by A/E shall be made good at expense of Contractor. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
1. Remove combustible rubbish materials and empty paint cans each day and safely dispose of same in accordance with requirements of authorities having jurisdiction.
2. Clean equipment and dispose of wash water/solvents as well as all other cleaning and protective materials (e.g. rags, drop cloths, masking papers, etc.), paints, thinners, paint removers/strippers in accordance with safety requirements of authorities having jurisdiction.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by A/E, and leave in an undamaged condition.
1. Erect barriers or screens and post signs to warn, limit or direct traffic away or around work area as required.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE (P-CODE)

A. Clay-Masonry Substrates:
1. Institutional Low-Odor/VOC Latex System: (Code #4.11)
a. Prime Coat: Primer Sealer, Interior, Institutional Low Order/VOC:
1) Sherwin Williams; Loxon Concrete and Masonry Primer
2) Pittsburgh Paints Company; 4-603xi Perma-Crete Alkali Resistant Primer
3) Benjamin Moore: Ultra Spec Masonry Int/Ext 100% Acrylic Sealer 608
4) Behr Pro Concrete & Masonry Primer No. PR060
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex **(semigloss)**.
1) Sherwin Williams; Pro Mar 200 Zero VOC

2) Pittsburgh Paints Company; Speedhide Zero, 0 VOC
3) Benjamin Moore: Ultra Spec 500 Interior Zero VOC Semi-Gloss T546
4) Behr IPRO 300 Semi-Gloss
5) Application includes, but is not limited to:
a) Interior Pressed and extruded brick, where indicated.

B. CMU Substrates:
1. Institutional Low-Odor/VOC Latex System: (Code #4.14)
a. Prime Coat: Interior/exterior latex block filler.
1) Sherwin Williams; PreRite Block Filler.
2) PPG; 6-15XI Speedhide Hi-Fill Latex Block Filler
3) Benjamin Moore: Ultra Spec HP Masonry Int/Ext High Build Block Filler 571
4) Behr Pro Block Filler Primer No. PR50
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
1) Sherwin Williams; Pro Mar 200 Zero VOC

C. Steel (Ferrous) Substrates:
1. Water-Based Dry-Fall System (over shop-applied primer): (Code #5.11).
a. Prime Coat: Not applicable.
b. Topcoat: Waterborne dry fall, flat or eggshell.
1) Sherwin Williams; Pro Industrial Waterborne Acrylic DryFall
2) Pittsburgh Paints Company; 6-725XI Speedhide Super Tech Interior Dry Fog.
3) Benjamin Moore: Latex Dry Fall Flat 395
4) Behr Pro Waterborne Acrylic Dryfall
5) Application includes, but is not limited to:
a) Beams and joists.
2. Institutional Low-Odor/VOC Latex System: (Code #5.12)
a. Prime Coat: Rust-inhibitive primer (water based).
1) Sherwin Williams; Pro Industrial Pro-Cryl Universal Primer
2) PPG: Pitt-Tech Plus EP Acrylic Primer, 90-1912
3) Benjamin Moore: Ultra Spec HP Acrylic Metal Primer HP04
4) Behr Metal Primer No. 435
5) Verify compatibility with primer, if shop-applied primer is used.
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
1) Sherwin Williams; B66-600 Pro Industrial High-Performance Acrylic or Pro Industrial Waterbased Alkyd Urethane, B53-2150 Series.
2) PPG: Pitt-Tech Plus EP DTM Acrylic, 90-1610 Series.
3) Benjamin Moore: Ultra Spec HP DTM Acrylic Enamel – HP25 (Low Luster) HP29 (Semi-Gloss)
4) Application includes, but is not limited to:
a) Beams and joists.
b) Hollow metal doors, including vision lite kits, frames, door mullions and astragals.
c) Miscellaneous ferrous metal surfaces, including exposed to view fire suppression, plumbing, HVAC, electrical, communication, and electronic safety and security item not prefinished where exposed in occupied spaces.
d) Access doors.
e) Exposed to view, in public areas, fire suppression, plumbing, HVAC, electrical communication, and electronic safety and security unfinished items.
3. Institutional Low-Odor/VOC Latex System: (Code #5.14)
a. Prime Coat: Bonding primer (water based).
1) Sherwin Williams; Extreme Bond Interior/Exterior Bonding Primer
2) PPG: Rust-Oleum X-I-M UMA Advanced Technology Primer Sealer Bonder.

3) Behr Bonding Primer No. 432
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
1) Sherwin Williams; B66-600 Pro Industrial Acrylic
2) PPG: Pitt-Tech Plus EP DTM Acrylic 90-15_.
3) Behr Premium Direct-to-Metal Semi-Gloss Gloss Paint No. 3200
4) Application includes, but is not limited to:
a) Existing metal surfaces with alkyd paint.

D. Galvanized-Metal Substrates:
1. Water-Based Dry-Fall System: (Code #5.31)
a. Prime Coat: Waterborne dry fall.
b. Topcoat: Waterborne dry fall, flat or eggshell.
1) Sherwin Williams; Pro Industrial Waterborne Acrylic DryFall
2) PPG; 6-725XI Speedhide Super Tech Interior Dry Fog.
3) Benjamin Moore: Latex Dry Fall Flat 395
4) Behr Pro Waterborne Acrylic Dryfall Flat No. HP210
5) Application includes, but is not limited to:
a) Overhead decking, pipes, ducts, etc.
b) Exposed metal acoustical deck.
2. Institutional Low-Odor/VOC Latex System: (Code #5.32).
a. Prime Coat: Waterborne galvanized-metal bonding primer. MPI #134.
1) Sherwin Williams: Pro Industrial Pro-Cryl Universal Primer
2) PPG: Pitt-Tech Plus EP Acrylic Primer, 90-1912.
3) Benjamin Moore: Ultra Spec HP Acrylic Metal Primer HP04
4) Behr Metal Primer No. 435
5) Note: Primer may be omitted, if not required by paint manufacturer.
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
1) Sherwin Williams: B66-600 Pro Industrial High-Performance Acrylic or Pro Industrial Waterbased Alkyd Urethane B53-2150 Series.
2) PPG; Pitt-Tech Plus EP DTM Acrylic, 90-1610 Series.
3) Benjamin Moore: Ultra Spec HP DTM Acrylic Enamel – HP29 (Semi-Gloss) HP-28 (Gloss)
4) Application includes, but is not limited to:
a) Hollow metal doors, including vision lite kits, frames, door mullions, and astragals.
b) Miscellaneous other non-ferrous surfaces, including supports.

E. Gypsum Board Substrates:
1. Institutional Low-Odor/VOC Latex System: (Code #9.21)
a. Prime Coat: Interior latex primer/sealer. .
1) Sherwin Williams; Pro Mar 200 Zero VOC Latex Primer
2) PPG; 6-2 Speedhide Quick Drying Latex Sealer
3) Benjamin Moore: Ultra Spec 500 Zero VOC Interior Latex Primer N534
4) Behr Premium Urethane Alkyd Semi-Gloss Enamel No. 3900
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex flat.
1) Sherwin Williams; Pro Mar 200 Zero VOC
2) PPG; Speedhide Zero, 0 VOC
3) Benjamin Moore: Ultra Spec 500 Interior Zero VOC - Flat T535
4) Behr IPRO 300 Interior Flat
5) Application includes, but is not limited to:
a) Horizontal gypsum surfaces.
2. Institutional Low-Odor/VOC Latex System: (Code #9.22)
a. Prime Coat: Interior latex primer/sealer.
1) Sherwin Williams; Pro Mar 200 Zero VOC Latex Primer
2) PPG; 6-2 Speedhide Quick Drying Latex Sealer
3) Benjamin Moore: Ultra Spec 500 Interior Zero VOC Latex Primer N534

4) Behr Premium Urethane Alkyd Semi-Gloss Enamel No. 3900

b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.

c. Topcoat: Institutional low-odor/VOC interior latex eggshell.

1) Sherwin Williams; Pro Mar 200 Zero VOC

2) PPG; Speedhide Zero, 0 VOC

3) Benjamin Moore: Ultra Spec 500 Interior Low Sheen Eggshell T537

4) Behr IPRO Interior Eggshell

5) Application includes, but is not limited to:

a) Vertical gypsum surfaces where cleaning is not frequently to occur.

3. Institutional Low-Odor/VOC Latex System: (Code #9.23)

a. Prime Coat: Interior latex primer/sealer.

1) Sherwin Williams; Pro Mar 200 Zero VOC Latex Primer

2) PPG; 6-2 Speedhide Quick Drying Latex Sealer

3) Benjamin Moore: Ultra Spec 500 Interior Zero VOC Latex Primer N534

4) Behr Premium Urethane Alkyd Semi-Gloss Enamel No. 3900

b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.

c. Topcoat: Institutional low-odor/VOC interior latex semigloss.

1) Sherwin Williams; Pro Mar 200 Zero VOC

2) PPG; Speedhide Zero, 0 VOC

3) Benjamin Moore: Ultra Spec 500 Interior Zero VOC Semi-Gloss T546

4) Behr IPRO Interior Semi-Gloss

5) Application includes, but is not limited to:

a) Vertical gypsum surfaces where cleaning is likely to occur.

F. Cotton or Canvas and ASJ Insulation-Covering Substrates:

1. Institutional Low-Odor/VOC Latex System: (Code #10.11)

a. Prime Coat: Interior latex primer/sealer.

1) Sherwin Williams; Pro Mar 200 Zero VOC Latex Primer

2) PPG; 6-2 Speedhide Quick Drying Latex Sealer

3) Benjamin Moore: Ultra Spec 500 Interior Zero VOC Latex Primer N534

b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.

c. Topcoat: Institutional low-odor/VOC interior latex (flat).

1) Sherwin Williams; Pro Mar 200 Zero VOC

2) PPG; Speedhide Zero, 0 VOC

3) Benjamin Moore: Ultra Spec 500 Interior Zero VOC – Flat T535 Low Sheen Eggshell T537

4) Behr IPRO Interior Flat and Eggshell

5) Application includes, but is not limited to:

a) Pipe and duct coverings.

END OF SECTION 09 91 23.00

SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and application of high-performance coating systems (HPC) on the following substrates:
   1. Interior Substrates:
      a. Concrete masonry units (CMU).
      b. Gypsum board.

B. Related Sections include the following:
   1. Division 09 painting Sections for special-use coatings and general field painting.

1.2 DEFINITIONS

A. Standard coating terms defined in ASTM D 16 apply to this Section.

B. Gloss ranges used in this Section include the following:
   1. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
   2. High gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of coating system and in each color and gloss of finish coat indicated.
   1. Submit Samples on rigid backing, 8 inches square.
   2. Step coats on Samples to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.5 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.

1.6 QUALITY ASSURANCE

A. Mockups: Apply benchmark samples of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. A/E will select one surface to represent surfaces and conditions for application of each type of coating and substrate.
      a. Wall Surfaces: Unless otherwise noted, first-in-place 100 sq.ft. of each product and surface may serve as mockup.
      b. Other Items: A/E will designate items or areas required.
   2. Apply benchmark samples after permanent lighting and other environmental services have been activated.

3. Final approval of color selections will be based on benchmark samples.
    a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by A/E at no added cost to Owner.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless A/E specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label with the following information:
1. Name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. Handling instructions and precautions.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers on Schedule at end of Section.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL (HPC)

A. Material Compatibility:
1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.

3. Provide products of same manufacturer for each coat in a coating system.

B. All materials used shall be lead, mercury, and cadmium-free and VOC compliant with local authorities with jurisdiction.

C. Colors: Refer to “List of Finishes”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
   1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows
      a. Masonry (CMU): 12 percent.
      b. Gypsum Board: 12 percent.

B. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
   1. Coating application indicates acceptance of surfaces and conditions.

E. Coordination of Work: Review other Sections in which primers or other coatings are provided to ensure compatibility of total systems for various substrates. On request, furnish information on characteristics of specified finish materials to ensure compatible primers.
   1. If a potential incompatibility of primers applied by others exists, obtain the following from the primer Applicator before proceeding:
      a. Confirmation of primer's suitability for expected service conditions.
      b. Confirmation of primer's ability to be top coated with materials specified.
   2. Notify A/E about anticipated problems before using the coatings specified over substrates primed by others.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
   1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.

C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
   1. Schedule cleaning and coating application so dust and other contaminates from cleaning process will not fall on wet, newly coated surfaces.
   2. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.

D. CMU Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

E. Gypsum Wallboard: Must be clean and dry. Fill nail heads must be set and spackled. Joints must be taped and covered with joint compound. Spackled nail heads and taped joints must be sanded smooth and all dust removed prior to painting.
   1. Vacuum wall with brush attachment.
      a. As wall is vacuumed, wipe if down with microfiber cloth. Piles of dust may accumulate near base. Be sure to vacuum this dust before you begin to paint; otherwise, it could become airborne and ruin your smoothly painted wall.
   2. Wipe down wall with microfiber cloth.
   3. Gently wash walls.
      a. Apply water sparingly. Let wall dry thoroughly before painting.
   4. Repeat steps until all traces of dust are removed.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.
   1. Use applicators and techniques suited for coating and substrate indicated.
   2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:
   1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
   2. Testing agency will perform tests for compliance with specified requirements.
   3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

B. Dry Film Thickness Testing: Owner reserves the right to engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
   1. Contractor shall touch up and restore coated surfaces damaged by testing.
   2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by A/E, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. CMU Substrates:
1. Epoxy Coating System: (Code #4.222).
a. Prime Coat: Epoxy block filler.
1) Sherwin Williams; Cement-Plex 875 Acrylic Block Filler, Kem Cati-Coat Epoxy Block Filler or Prep Rite Block filler.
2) Pittsburgh Paints Company; Amerlock 400BF
3) Tnemec; Series 130 Enviro-Fill
4) Benjamin Moore; Ultra Spec Masonry Int/Ext High Build Block Filler 571
b. Intermediate Coat: Epoxy, gloss.
c. Topcoat: Epoxy, gloss.
1) Sherwin Williams; Pro Industrial Hi Performance Epoxy
2) Pittsburgh Paints Company; Amerlock 600
3) Tnemec; Series 49 Multi-Purpose Epoxy
4) Benjamin Moore: Corotech Polyamide Epoxy Coating Gloss/SG V400
d. Application includes, but is not limited to:
1) Wet environments where additional abrasion resistance is required, e.g. Water-Based Epoxy Coating System: (Code #4.224).
a. Prime Coat: Interior/exterior latex block filler.
1) Sherwin Williams; Pro Industrial Heavy Duty Block Filler
2) Pittsburgh Paints Company; 6-15XI Speedhide Hi-Fill Block Filler
3) Tnemec; Series 54 Masonry Filler
4) Benjamin Moore; Ultra Spec Masonry Int/Ext High Build Block Filler 571
b. Intermediate Coat: Water-based epoxy (interior), semi-gloss.
c. Topcoat: Water-based epoxy (interior), semi-gloss.
1) Sherwin Williams; Pro Industrial Pre-Catalyzed Epoxy
2) Pittsburgh Paints Company; 16-510 Pitt-Glaze WB1 Pre-Catalyzed Epoxy
3) Tnemec; Series 113 HB Tneme-Tufcoat
4) Benjamin Moore: Corotech Pre-Catalyzed Waterborne Epoxy Semi-Gloss V341
d. Application includes, but is not limited to:
1) Dry environments additional abrasion-resistance is required (for example, toilet rooms).
3.

B. Gypsum Board Substrates:
1. Water-Based Epoxy Coating System: (Code 9.211).
a. Prime Coat: Interior latex primer/sealer.
1) Sherwin Williams; ProMar 200 Zero VOC Interior Latex Primer
2) Pittsburgh Paints Company; 6-2 Speedhide Quick Drying Latex Sealer
3) Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534
b. Intermediate Coat: Water-based epoxy (interior and exterior).

c. Topcoat: Water-based epoxy, semi-gloss (interior and exterior).
   1) Sherwin Williams; Pro Industrial Pre-Catalyzed Epoxy
   2) Pittsburgh Paints Company; 16-1510 Pitt-Glaze WB1 Pre-Catalyzed Epoxy
   3) Benjamin Moore; Corotech Pre-Catalyzed Waterborne Epoxy V341
d. Application includes, but is not limited to:
   1) High traffic areas where frequent cleaning with detergent and industrial cleaners is likely to occur e.g. toilet room.

END OF SECTION 09 96 00

SECTION 09 72 16.01 – CUSTOM DIGITAL IMAGE WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Custom digital image wall covering (CVWC).

B. Work under this contract shall also include, but not necessarily be limited to:
   1. Surface preparation of substrates as required for acceptance of wall coverings including cleaning, small crack repair, patching, and making good surfaces and areas to the limits defined under preparation requirements of wall covering manufacturer.

C. Related Sections include the following:
   1. Division 09 Section "Interior Painting" for primers, coatings, and paint for wall coverings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.
   2. Include manufacturer’s recommendations for maximum permissible moisture content of substrates.

B. Samples for Verification: 8-1/2 inch by 11 inch section of wall covering from lot to be used for each type of wall covering indicated for each color, texture, and pattern required.
   1. Digital Image Wallcovering
      a. Submit one color proof for approval prior to manufacturer of a full size miniature mural.
      b. Submit on full size miniature strike-off for approval prior to the manufacturer of full size mural.

1.3 QUALITY ASSURANCE

A. Qualifications of Installers: For actual cutting and installation of wall covering, use only thoroughly trained and experienced installers completely familiar with the installation recommendations of the manufacturer of the wall covering used; and completely familiar with the requirements of this Work.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate appearance and aesthetic effects and set quality standards for installation. At the beginning of the installation, prepare one wall (approximately 60 sq.ft.) as indicated by A/E for each finish required.
   1. Provide a mockup for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless A/E specifically approves such deviations in writing.
   3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver all wall covering materials in sealed, original labeled containers bearing manufacturer’s name, brand name, color/texture designation, type, weight, roll/batch sequence, fire-rating and standard compliance, as well as application requirements. Only approved products shall be delivered to the site.

B. Store all wall covering materials in original labeled containers flat in a secure (lockable) dry, heated and well ventilated single designated area meeting manufacturer's minimum (50 degrees F) temperature and humidity requirements, for a minimum of 36 hours before installation.

C. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
   1. Do not cross stack this material.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not install wall coverings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
   1. Unless specifically pre-approved in writing from wall covering product manufacturer, perform no work when the ambient air and substrate temperatures are below 50 deg. F or when the relative humidity is above 85 percent or when the dew point is less than 5 deg. F variance between the air/surface temperatures.

B. Perform no wall covering work when the maximum moisture content of plaster and gypsum board substrates exceeds 12 percent. Conduct moisture tests using a properly calibrated electronic moisture meter.

C. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.

D. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.
   1. Provide supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

E. Apply wall coverings only to clean, dry, properly cured, and adequately prepared surfaces in areas where dust is no longer generated by construction activities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. All wall covering materials shall be from or approved by a single manufacturer for each system used.

2.2 PERFORMANCE REQUIREMENTS

A. Low-Emitting Materials: Wall-covering system shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers".

B. Fire-Test-Response Characteristics: Provide wall coverings and adhesives with the following fire-test-response characteristics as determined by testing identical products applied with identical adhesives to substrates per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Surface-Burning Characteristics: As follows, per ASTM E 84:
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 50 or less.

2.3 DIGITAL IMAGING WALL COVERING

A. Basis-of-Design: Subject to compliance with requirements, provide product named on "List of Finishes" or a comparable product by one of the other manufacturers specified.
   1. D.L. Couch
   2. MDC
   3. Koroseal

B. Custom Digital Imaging Wallcovering
   1. Digital wall-covering shall be printed on 53 inch/54 inch vinyl wall-covering substrate using piezo drop-on-demand technology incorporating a minimum of eight colors. Printed image shall be dried from both front and back using combinations of IR and platen heaters to prevent media distortion.
   2. Vinyl Wall-covering substrate: Through pigmented, mildew inhibitorized polyvinyl chloride, adhered to cotton, cotton/blend fabric backing, or a cellulose polyester non-woven backing. All materials shall be Cadmium and Mercury free, and shall confirm to the CFFA-W-101-B.
      a. Weight: minimum 13 ounces per square yard.
      b. Backing Weight: minimum 2 ounces per square yard.
   3. Pattern, Image and color: As indicated in List of Finishes.

C. Digital Image: Owner to provide PDF file of image to be digitally printed.

2.4 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall-covering manufacturer.
   1. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers".

B. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Division 09 Section "Interior Painting" and recommended in writing by wall-covering manufacturer for intended substrate.

C. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended by wall-covering manufacturer.
   1. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation and MPI Painting Manual requirements.

B. Clean substrates of substances that could impair wall covering's bond, including mold, mildew, oil, grease, incompatible primers, dirt, and dust.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
   1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
   2. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
   3. Painted Surfaces: Treat areas susceptible to pigment bleeding.
      a. Check painted surfaces for pigment bleeding.
      b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.

D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

F. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.
   1. Provide wall liner, where required to correct inadequate substrate conditions with no gaps or overlaps, where required by wall covering manufacturer.

3.3 INSTALLATION

A. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated and MPI Painting Manual finish requirements with application methods in accordance with best trade practices for type and application of materials used.

B. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.
   1. Fill in spaces above and below openings in sequence from the roll, and not at a later date when full-length pieces have been installed.

C. Install strips in same order as cut from roll.
   1. Install reversing every other strip, where recommended by wall covering manufacturer.
   2. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
   3. Match pattern 72 inches above the finish floor.

4. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
5. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
    a. Apply adhesive in a uniform coat to the back of material or to wall surface, within the time frame recommended by adhesive manufacturer. Take special care to prevent particles, grit, dirt, or other foreign matter from being imbedded beneath the wall covering.
    b. Use stiff bristle brush or flexible broad knife to eliminate air pockets and to secure the wall covering to the wall surfaces. Installed wall covering shall secure, smooth, and clean, without wrinkles, gaps, and overlaps.
6. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.
7. Remove excess adhesive from each seam as it is made, and before proceeding to the next seam. Use a sponge dampened with clean water, but not wringing wet. Wipe seam clean with dry cloth towel.

3.4 CLEANING

A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 72 16

DIVISION 10

SPECIALTIES

SECTION 10 11 00 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Reinstallation of visual display board assemblies

B. Related Sections include the following:
   1. Division 02 Section “Selective Demolition” for removal of visual display boards.

1.2 PREINSTALLATION MEETINGS

A. Preinstall Meeting: Conduct meeting at Project site.
   1. Review blocking requirements.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Adhesives: Manufacturer’s standard product that complies with the testing and product requirements of the California Department of Health Services’ “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances, such as dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.

B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, and substances that will impair bond between and surfaces.

3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Factory-Fabricated Visual Display Board Assemblies: Provide one of the following:
   1. Adhere to wall surfaces with egg-size adhesive gobs at 16 inches o.c., horizontally and vertically.
   2. Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

3.4 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 10 11 00

SECTION 10 14 19 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fabricated channel dimensional characters.

B. Related Sections
   1. Division 07 Section “Metal Roof Panels” for coordination.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For dimensional letter signs.
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
   3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.

C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
   1. Dimensional Characters: Full-size Sample of dimensional character.

D. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.
   1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS:

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Maintenance Data: For signs to include in maintenance manuals.
   2. Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering.
      b. Separation or delamination of sheet materials and components.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers: Subject to compliance with requirements, provide signage by one of the manufacturers specified herein.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” Sample sign, and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of rooftop dimensional character sign type to withstand design loads as indicated on Drawings.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
   1. Uniform Wind Load: As indicated on Drawings.
   2. Concentrated Horizontal Load: As indicated on Drawings.
   3. Other Design Load: As indicated on Drawings.
   4. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.3 DIMENSIONAL CHARACTERS

A. Fabricated Channel Characters: Metal face with metal side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability and for securing fasteners; and as follows.
   1. Manufacturers: Subject to compliance with requirements, provide signage by one of the manufacturers specified.
      a. A.R.K. Ramos
      b. ASI – Sign Systems, Inc.
      c. Charleston Industries
      d. APCO Graphics, Inc.
      e. Metallic Arts

f. Sign & Decal Corp.
g. Steel Art Company
h. Gemini Incorp.
i. ACE Sign Systems
j. Mathews International
k. Interior Graphic Systems
l. Ellet Sign Company
m. Cosco

2. Character Material: Sheet or plate aluminum.
3. Material Thickness: Manufacturer's standard for size and design of character.
4. Character Height: As indicated.
5. Character Depth: As indicated.
6. Finishes:
   a. Powder-Coat Finish: Manufacturer's standard, in color as indicated in List of Finishes. If not indicated as selected by A/E from manufacturer's full range.
7. Mounting: Concealed, painted aluminum back bar or bracket assembly.
8. Typeface: As indicated.

2.4 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.5 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
   1. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
   1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
   2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
   3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
   4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
   5. Internally brace signs for stability and for securing fasteners.
   6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
   1. Stainless-Steel Brackets: Factory finish brackets to match sign background with No. 4 finish unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
   1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
   2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
   3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:
   1. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 19

SECTION 10 14 53 - TRAFFIC SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes post-mounted exterior signage for traffic control and parking designation.
   1. Traffic signs
   2. Accessible parking signs.

B. Related Sections include the following:
   1. Division 03 Section “Cast-In-Place Concrete”.

1.3 REFERENCES

A. Department of Transportation (DOT) Construction and Materials Specifications.

B. US Manual on Uniform Traffic Control Devices for signs within public rights-of-way.

1.4 SYSTEM DESCRIPTION

A. Design Requirements
   1. Comply with requirements of local authorities having jurisdiction in executing signage work.
   2. Accessibility Requirements: Provide site improvements to conform to the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local Regulations. These requirements supersede Technical Specifications in this Section.

B. Performance Requirements: Obtain all required permits related to the Work of this Section.

1.5 SUBMITTALS

A. Shop Drawings: For items included in this Section. Include types of materials, construction details, sizes and layout, and complete information on accessories.
   1. Exterior traffic control signage drawings shall be to scale.

PART 2 - PRODUCTS

2.1 POST-MOUNTED PARKING SIGNS

A. Parking Signs.
   1. Exterior “Accessible Parking” Signs.
      a. 12 by 18 inch, 18-guage steel or .063-inch aluminum with 1 inch radius corners. Bolt through top and bottom of sign face into 2 by 2 inch square steel post by 11 foot long (3.65 pounds/feet), with vandal-resistant fasteners. Color for post is to be selected by Architect.
   2. Signage Finishes: Baked enamel finish. Comply with requirements of ODOT and MUTCD (Manual of Unified Traffic Control Devices).

2.2 POST-MOUNTED TRAFFIC CONTROL SIGNS

A. General: Sign material shall consist of 18-gauge bonderized steel or .080-inch aluminum for stop, yield; and Do Not Enter signs.

B. Traffic Control Signs: Comply with legal authorities and standards.

2.3 SETTING MATERIAL

A. Concrete: Minimum 28 day compressive strength of 3,000 psi (20 MPa).

2.4 BREAK AWAY BOLTS

A. Break Away Bolts: Meet AASHTO (American Association of State Highway Transportation Officials) Guidelines for roadside signage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. As indicated on the drawings. Set all signs vertical and plumb.

END OF SECTION 10 14 53

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes following:
   1. Public-use washroom accessories.
   2. Special needs accessories.

B. Owner-Furnished Material:
   1. Toilet paper dispenser
   2. Sanitary napkin dispenser
   3. Paper towel dispenser
   4. Soap dispenser
   5. Trash/recycling container

C. Related Sections include following:
   1. Division 06 Section “Miscellaneous Rough Carpentry” for blocking in walls.
   2. Division 08 Section “Flush Wood Doors” for coordination with coat hooks.
   3. Division 09 Section “Gypsum Board Assemblies” for blocking coordination.

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying Work.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include following:
   1. Construction detail, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Anchoring and mounting requirements, including requirements for cutouts in other work, substrate preparation, and installation methods, including templates and rough-in measurements.
   3. Storage and handling requirements and recommendations.
   4. Features that will be included for Project.

B. Performance Requirement Verification: Provide verification that installation of products will result in compliance with “Performance Requirements” indicated. This may include calculations, testing results, manufacturer installation and attachment requirements, fastener information for indicated substrate, or other means necessary to demonstrate compliance.
   1. Include manufacturer’s installation instructions to meet required loads.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated on Drawings.
   2. Identify products using designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Maintenance Data: For toilet and bath accessories to include in maintenance manuals; including replacement parts information along with cleaning and maintenance instructions.
   2. Warranty: Special warranties specified in this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Protect

B. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap and packaging to be returned to manufacturer for recycling into new product.
   2. Separate corrugated cardboard and packaging in accordance with Waste Management Plan and place in designated areas for recycling.

1.7 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: Comply with requirements applicable in jurisdiction of project, including but not limited to ADA and ICC/ANSI A117.1 requirements as applicable.
   1. Where bottoms of units are between 27 and 80 inches above finished floor, accessories mounted on or in wall cannot protrude more than 4 inches into a clear access aisle.

B. Structural Performance: Accessories and fasteners to comply with the following requirements:
   1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
   2. Changing Stations:
      a. Adult-Changing Station: Installed units are able to resist 500-pound static load.

2.2 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of manufacturers specified.
   2. Products: Subject to compliance with requirements, provide one of specified products.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed material requirements and functional qualities of specified product. Requests for A/E's approval and complete technical data for evaluation must be received at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.3 MATERIALS

A. Stainless Steel: ASTM A 240 or ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Steel Sheet: ASTM A 1008, Designation CS (cold-rolled, commercial steel), 0.0359-inch minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A 653, with G60 hot-dip zinc coating.

D. Galvanized-Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of stainless or galvanized steel where concealed.

F. Chrome Plating: Not acceptable.

G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0-mm thick.
   1. Provide mirror furnished with a uniform plastic film 8 mils nominal thickness with acrylic adhesive which is moisture resistant and non-corrosive, meeting 16 CFR 1201-11 and ANSI 297.1 requirements category II tape back.

H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.4 PUBLIC-USE WASHROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of manufacturers specified.
   1. AJW Architectural Products
   2. American Specialties, Inc. (ASI)
   3. Bobrick Washroom Equipment, Inc.
   4. Bradley Corporation.
   5. GAMCO Commercial Restroom Accessories Division, Bobrick Washroom Equipment, Inc.

B. Toilet-Tissue (Roll) Dispenser: Owner-furnished.

C. Paper-Towel Dispenser: Owner-furnished.

D. Waste Receptacle: Owner-furnished.

E. Liquid-Soap Dispenser: Owner-furnished.

F. Grab Bar:
   1. Stainless Steel Type: Provide grab bars with wall thickness not less than 0.05 inch and as follows:
      a. Mounting: Concealed, manufacturer's standard flanges and anchorages.
      b. Clearance: 1-1/2-inch clearance between wall surface and inside face of bar.
      c. Gripping Surfaces
         1) Smooth, satin finish, unless noted otherwise.
         2) Manufacturer's standard nonslip texture in wet areas.
      d. Heavy-Duty Size: Outside diameter of 1-1/4 inches minimum.

2. Grab bar shall be constructed of Type 304 stainless steel with satin finish. Concealed mounting flanges shall be 1/8-inch-thick stainless-steel plate, 3-1/8-inch diameter, and each shall have 2 screw holes for attachment to wall. Flange covers shall be 0.03125-inch thick (fka 22-gauge), 3-1/4-inch diameter by 1/2-inch deep and shall snap over mounting flange to conceal mounting screws. Ends of grab bars shall pass through concealed mounting flanges and be heliarc-welded to form one structural unit. Grab bars shall comply with ADA Accessibility Guidelines for structural strength. Provide concealed anchor device or backing as specified or required in accordance with local building codes before wall is finished.
    a. Products:
        1) Bobrick: B-5806 Series
            a) (GB3): B-5806 by 18 (V)
            b) (GB6): B-5806 by 36
            c) (GB7): B-5806 by 42
        2) Bradley: 832-001 Series
            a) (GB3): 832 by 18 (V)
            b) (GB6): 832 by 36
            c) (GB7): 832 by 42
        3) AJW Architectural Products: UG2 Series
            a) (GB3): UG2-A by 18 (V)
            b) (GB6): UG2-A by 36
            c) (GB7): UG2-A by 42
        4) American Specialties: 3701 Series
            a) (GB3): 3700 by 18 (V)
            b) (GB6): 3700 by 36
            c) (GB7): 3700 by 42
        5) Gamco: 125S-Series
            a) (GB3): 1255 by 18 (V)
            b) (GB6): 125S by 36
            c) (GB7): 125S by 42

G. Sanitary-Napkin/Tampon Accessories: Owner-furnished.

H. Mirror Unit, Glass:
1. Stainless-Steel Framed Mirror (M-1 - M-4): Mirror shall have a one-piece, Type 304 stainless-steel angle frame, 3/4 inch by 3/4 inch with continuous integral stiffener on all sides and beveled front to hold frame tightly against mirror; corners shall be heliarc-welded, ground, and polished smooth; all exposed surfaces shall have satin finish with vertical grain. Float/plate glass mirror shall be guaranteed for 15 years against silver spoilage. All edges shall be protected by plastic filler strips and back shall be protected by full-size, shock-absorbing, water-resistant, nonabrasive, 1/8-inch-thick polyethylene padding. Corrugated cardboard is not an acceptable filler material. Galvanized-steel back shall have integral hanging brackets for mounting on concealed rectangular wall hanger(s). Mirror shall be secured to hanger(s) with concealed Phillips-head locking screws located in bottom of frame.
    a. Products:
        1) Bobrick: B-290
        2) Bradley: MIR780
        3) AJW Architectural Products: U700
        4) American Specialties: 0600
        5) Gamco: A-Series

I. Coat Hooks (CH):
1. Surface-mounted stainless-steel towel pin shall be constructed entirely of Type 304 stainless steel with bright polished finish. Flange shall be equipped with 0.0625-inch thick (fka 16-gauge) mounting bracket which locks to concealed 0.0625-inch thick (fka 16-gauge) wall plate with stainless-steel lock screw. Cap shall be 0.1406-inch thick (fka 10-gauge) stainless steel, welded to post.

a. Products:
    1) Bobrick: B-7671
    2) Bradley: 9115
    3) AJW Architectural Products: UX110BF
    4) American Specialties: 7340-B
    5) Gamco: 7671

2.5 SPECIAL NEEDS ACCESSORIES

A. Surface-Mounted Adjustable Height Adult Changing Station:
1. Basis-of-Design: Model KB3000-AHL as manufactured by Koala Kare Products, a Division of Bobrick or comparable by one of the listed manufacturers.
    a. Foundations Worldwide, Inc.
    b. Pressalit Inc.
    c. Smirthwaite USA LLC; Prism Medical Group
2. Safety: Unit tested to meet ISO 60601 and ISO 17966. Unit shall have a battery backup system to safely operate changing bed in the event of a power interruption.
3. Unit designed to have redundancy by being equipped with two chains for height adjustability.
4. Emergency Stop: Unit is equipped with emergency stop to break power to actuator in an emergency.
5. Powered-Height Adjustability: Electronically adjustable from 12 to 41 inches. Unit has 2 sets of electronic controls; located on face of wall cover; and, on front of changing bed in open, down position.
6. Front Safety Guard: One-hand operation. Guard shall lock in raised position along front side of changing bed. Guard shall have dip in top edge to facilitate caregiver reaching over guard to change patient. Guard shall rotate and lock under changing bed in stored position.
7. Weight Capacity: Tested to support 500 lbs. static load.
8. Durability: Cycle tested through range of motion 28,000 times at 500 lbs. Stress tested to 100,000 cycles with 500 lbs. bounce load test. Meets IK10 impact rating.
9. Cleaning: The unit shall be designed and tested to meet IPX4 rating and shall have no exposed wiring/cables for disinfecting and cleaning. Unit can be hosed without compromising the electronics.
10. Frame: Shall be constructed of 2 inch powder coated steel tubing.
11. Changing Bed: Surface shall be 75-1/4 inch long, 31-1/2 inch wide. Can be raised and lowered with one-hand. Produced from UHMW PE 1000 to be cut resistant while providing hammock for comfort. Surface shall be designed to be replaceable in the field.
12. Warranty: Three year limited warranty on parts; one year on labor.
13. Electrical: The unit shall operate at 24V/via 120V wall outlet. It shall include a grounding power cord and have splash proof control system rated at IPX4.
    1) Safe-Strap Company, Inc.; Diaper-Depot Horizontal
    2) Saniflow, a mediclinics Company; CP0016HCS
    b. Color shall be selected by A/E from manufacturer's standards.

2.6 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent moisture accumulation, as follows:
1. Provide galvanized-steel backing sheet, not less than 0.0336-inch thick (fka 22-gauge) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

C. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.
   1. Accessories are to be keyed alike, unless otherwise noted.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate requirements for blocking and construction of wall openings.

B. Provide templates and rough-in measurements as required.

C. Verify required electrical services have been properly installed.

3.2 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
   1. Verify blocking, if required, has been installed properly.
   2. Verify location does not interfere with door swings or use of fixtures.
   3. Comply with manufacturer’s recommendations for backing and proper support.
   4. Use vandal-resistant fasteners and anchors suitable for substrate and project conditions.
   5. Conceal evidence of drilling, cutting, and fitting to room finish.
   6. Test for proper operation.

B. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer's instructions for type of substrate involved.

C. Grab Bars: Install to comply with specified structural-performance requirements.

D. Changing Stations: Install in accordance with manufactured instructions.
   1. Changing stations and other accessories shall be installed to comply with requirements for accessible mounting heights, protrusions into accessible routes, and other requirements of ICC/ANSI A117.1.
   2. Install units so they are level, plumb, and secure.
   3. After installation, open and close units a minimum of 3 times. Verify units operate smoothly and properly latch. Adjust as required for proper safe use.
   4. Wash exposed surfaces using a solution of mild detergent in warm water, applied with soft, clean cloths. Do not use abrasives.

3.3 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 28 00

SECTION 10 41 16 – LOCK BOX

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Furnishing and installing fire department lock boxes for building master key(s) as indicated.

1.2 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's standard published data for purchased items being incorporated into the Work at Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Heavy-duty key vault, recessed mounted. Subject to compliance with requirements (including approval by the local fire department), provide a product manufactured by the following:
   1. Knox Vault Model 3200

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least ten days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 FABRICATION

A. Provide boxes with the following components and properties:
   1. Rough-in Dimensions: 6-inches high by 6-inches wide by 4-inches deep.
   2. Provide lock box with 1/4-inch thick plate steel housing and 1/2-inch thick solid steel door.
   3. Door gasket seal for weather protection and 1/8-inch thick stainless steel dust cover with tamper seal mounting capability.
   4. Steel Finish: Pre-treatment zinc phosphate, F.S. TT-C-490, Type II.
   5. Boxes and lock shall be UL-listed.
   6. Lock shall have double action rotating tumblers and hardened steel pins, accessed by a bias-cut key.
   7. Provide recessed mounting kit.
   8. Finish Color: As selected by A/E from manufacturer's standard colors and finishes.

B. Order form for lock boxes and padlock shall be obtained and signed by an authorized officer of the local fire department.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lock boxes and accessories as recommended by manufacturer at location indicated.
   1. Set-in-place during masonry wall construction.

END OF SECTION 10 41 16

SECTION 10 43 13 – DEFIBRILLATOR CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes reinstallation of existing steel cabinets with automatic external defibrillators (AEDs).

B. Related Requirements:
   1. Division 02 Section “Selective Demolition” for coordination with salvage and reuse.
   2. Division 10 Section “Fire Extinguisher Cabinets.”

1.2 REFERENCES

A. Reference Standards: The publications listed below form a part of this Section to the extent referenced. The publications are referred to within the text by the basic designation only.
   1. American Heart Association (AHA): 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care.
   2. Department of Homeland Security’s “Stop the Bleed” program.

PART 2 - PRODUCTS

2.1 GENERAL

A. Reinstall salvaged cabinet and defibrillator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions:
   1. Prior to installation of defibrillator cabinets, verify that substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer’s instructions.
   2. Examine conditions affecting performance of work, with Installer present, for compliance

3.2 INSTALLATION

A. General: Comply with manufacturer’s installation instructions applicable to products and applications indicated, including product technical bulletins, product catalog installation instructions, and product carton installation instructions to comply with applicable regulations.

B. Automated External Defibrillator Cabinets: 48 inches above finished floor to top of defibrillator.

C. Automated External Defibrillator Cabinets: Fasten cabinets to structure, square and plumb.
   1. Fasten mounting brackets to inside surface of automated external defibrillator cabinets, square and plumb.

3.3 ADJUSTING

A. Adjust defibrillator cabinet doors to achieve smooth operation.

3.4 CLEANING

A. Upon completing installation, remove surplus and excess materials, rubbish, tools, and equipment.

3.5 PROTECTION

A. Protect installed products from damage during construction.

END OF SECTION 10 43 13

SECTION 10 44 13 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fire protection cabinets for the following:
a. Portable fire extinguishers.

B. Related Sections:
1. Division 02 Section “Selective Demolition” for coordination with existing fire extinguishers to be salvaged and reinstalled.
2. Division 10 Section "Fire Extinguishers."

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination
1. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
a. Field Measurement: Verify dimensions of existing recessed wall openings by field measurements before fabrication and indicate measurements on Shop Drawings.
2. Coordinate sizes and locations of fire protection cabinets with wall depths.

B. Pre-installation Meetings
1. Pre-installation Meeting: Conduct meeting at project site.
a. Review methods and procedures related to fire extinguishers including, but not limited to the following:
1) Schedules and coordination requirements.

C. Sequencing
1. Apply decals or vinyl lettering on field-painted fire-protection cabinets after painting is complete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semi-recessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on drawings.

1.5 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management” and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.
   2. Separate corrugated cardboard and packaging in accordance with Waste Management Plan and place in designated areas for recycling.
   3. Fold up metal banding, flatten, and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   2. Products: Subject to compliance with requirements, provide one of the products specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of specified product. Requests for A/E's approval must be accompanied by the “Substitution Request Form” and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. U.S. Architectural and Transportation Barriers Compliance Board, Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG), Adopted in 1991; Continual revisions as published in Federal Register.
   1. These regulations shall supersede Technical Specifications of this Section.

2.3 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304.

B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).
   1. Note: Wire glass and acrylic sheets are not acceptable.

2.4 FIRE PROTECTION CABINET

A. General: Reinstall existing fire extinguishers in new cabinets.
   1. Coordinate size of cabinets with fire extinguishers.

B. Cabinet Type: Suitable for fire extinguisher.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. J. L. Industries, Inc., a division of Activar Construction Products Group.
      b. Larsen's Manufacturing Company.
      c. Modern Metal Products, Division of Technico Inc.
      d. Guardian Fire Equipment, Inc.
      e. Potter Roemer LLC; Alta Series.
      f. Moon American.

g. Nystrom, Inc.
h. Babcock-Davis.
i. Oval Fire Products
j. Croker; a Division of Morris Group International

C. Cabinet Material: Stainless-steel sheet.

D. Semi-recessed Cabinet (SR-): Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation.
1. Rolled-Edge Trim: 4-inch backbend depth, maximum.

E. Door Material: Stainless-steel sheet.

F. Door Style:
1. Vertical duo panel with frame, unless otherwise noted.

G. Door Glazing: Tempered float glass (clear).

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
1. Provide recessed door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

I. Accessories:
1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
1) Location: Applied to cabinet door.
2) Application Process: Silk-screened, engraved, etched, or die cut.
a) Pressure-sensitive vinyl letters or decals are not acceptable.
3) Lettering Color: Red.
4) Orientation: Vertical.

J. Finishes:
1. Stainless Steel: No. 4.

2.5 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Miter corners and grind smooth.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick, unless otherwise noted.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semi-recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
1. Unless otherwise indicated, provide semi-recessed fire protection cabinets.
2. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
3. Seal any through penetration with firestopping sealant as specified in Division 07 Section “Penetration Firestopping”.

C. Identification: Apply decals or vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturers written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Sections:
1. Division 02 Section “Selective Demolition” for salvaging and reinstallation of existing fire extinguishers.
2. Division 10 Section "Fire Extinguisher Cabinets."

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination
1. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

1.4 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Warranty: Sample of special warranty.
2. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.
2. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, following:
      a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within warranty period.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of manufacturers specified.
   1. Portable Fire Extinguishers
      a. Amerex Corp.
      b. Ansul Inc.
      c. Bobcock-Davis
      d. Badger Fire Protection
      e. Buckeye Fire Equipment Company
      f. Fire End and Croker Corp.
      g. Guardian Fire Equipment, Inc.
      h. J.L. Industries; a division of Activar Construction Products Group
      i. Kidde, Residential and Commercial Div., UTC Fire and Security Co., United Technologies Corp.
      j. Larsen’s Manufacturing Company
      k. Moon America
      l. Nystron Building Products
      m. Potter-Roemer
      n. Pem All Fire Extinguisher Company, A Division of PEM System
      o. Pyro-Chem, Tyco Safety Products
      p. Strike First Corp. of America
      q. Oval Fire Products

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed material requirements and functional qualities of specified product. “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain fire extinguisher, fire-protection cabinets, and accessories, from a single source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, “Portable Fire Extinguishers”.

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.3 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. General: Salvage and reinstall existing fire extinguishers, as indicated.

B. Additional Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
   1. Valves: Manufacturer's standard, unless otherwise noted.
   2. Handles and Levers: Manufacturer's standard, unless otherwise noted.
      a. Gauge face cover and horn cone parts shall be metal. No plastic or nylon valves, trigger/handle, casing, or gauge will be acceptable.
   3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

C. Multipurpose Dry-Chemical Type in Steel or Aluminum Container: UL-rated 4-A:60-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled container.
   1. Provide this type throughout addition, unless otherwise noted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
   1. Mounting: 48 inches above finished floor to handle of fire extinguisher, unless required by authorities with jurisdiction.

END OF SECTION 10 44 16

SECTION 10 73 26 – ARCHITECTURAL CANOPIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Pre-engineered canopies and related items.

1.2 ACTION SUBMITTALS

A. Product Data: Include styles, material descriptions, construction details, fabrication details, dimensions of individual components and profiles, hardware, fittings, mounting accessories, features, finishes, for coverings.

B. Shop Drawings: Show location and extent of covering. Include elevations, sections, and details not shown in Product Data. Show materials, fabrication, dimensions, mounting heights, connections, anchorages, and installation details, attachments to other work, operational clearances, and relationship to adjoining work.
   1. Show locations for blocking, reinforcement, and supplementary structural support to be provided by others.
   2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Calculate requirements for supporting covering. Verify capacity of members and connections to support loads and verify loads, point reactions, and locations for attachment of awnings to structure with those indicated on Drawings.

C. Samples for Initial Selection: For each colored or finished component indicated. Furnish manufacturers standard color charts.

D. Samples for Verification: For each of the specified products and for the full range of color, texture, and pattern variations required. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Design Data: Design calculations bearing the seal of a registered professional engineer, licensed in the State where the project is located. Design calculations shall state that the walkway cover system design complies with the wind requirements of ASCE 7, the stability criteria of applicable building code, and all other governing criteria.

1.4 CLOSEOUT SUBMITTALS:

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Maintenance Data: For coverings to include in maintenance manuals. Include the following:
      a. Methods for maintaining finishes.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
   1. Fabricator's responsibilities include fabricating and installing and providing professional engineering services needed to assume engineering responsibility.

1.6 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of awnings in exterior locations to be performed according to manufacturers' written instructions.

B. Field Measurements: Where covering installation is indicated to fit to other work, verify dimensions of other work by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Super Limideck HR Hanger Rod Support shall be manufactured by the Mapes Industries, Inc.; specified as the type, size, function, and quality of the products required.

B. Comparable products of the following manufacturers will be considered, providing their products equal or exceed the quality specified; and they can provide products of the type, size, function, and arrangement required:
1. Dittmer Architectural Aluminum
2. E.L. Burns Co., Inc.
3. Texas Aluminum Industries, Inc.
4. Metal USA Building Products L.P.
5. MASA Architectural Canopies
6. JAG Metal Solutions.
7. Peachtree Protective Covers

C. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. General: Design, fabricate, and install coverings to withstand loads from gravity, wind, snow, ponding, drift, seismic, and structural movement, including thermally induced movement; and to resist, without failure, other conditions of in-service use, including exposure to weather.

B. Structural Performance: Provide coverings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated and in accordance with ASCE 7.
1. Wind Loads: As indicated.

C. Thermal Movements: Provide coverings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.3 MATERIALS

A. Decking shall consist of 3 inch extruded flat soffit .078 decking.

B. Intermediate framing members shall be extruded aluminum, alloy 6063-T-6, in profile and thickness required to meet "Performance Requirements".

C. Hanger rods and attachment hardware shall be a standard finish.

D. Fascia shall be standard extruded 8 inch “J” style.

E. Fasteners: Aluminum, 18-8 stainless steel, or 300 Series stainless steel.

F. Aluminum Flashing: ASTM B209, Type 3003 H14, 0.040-inch, minimum.

2.4 FABRICATION

A. General: Canopies shall be the size, length, and configuration indicated.
   1. Canopies shall be shipped with materials precut to size for field assembly.
   2. All connections shall be mechanically assemblies utilizing 3/16-inch fasteners with a minimum shear stress of 350 lb.

B. Fascia: Manufacturer’s standard shape. Provide fascia splices where continuous runs of fascia are joined. Locate splices to be in line with bents and fasten in place on hidden or non-vertical surfaces.

C. Erection: Erection shall be in accordance with manufacturer shop drawings. Erection shall be performed by manufacturer's approved and authorized agents or dealer. All bents shall be straight and true in accordance with the approved shop drawings. Care shall be taken to prevent damage or scratching; all components of canopy to be cleaned on completion and work area left in a neat condition.

2.5 FINISHES

A. General: Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations relative to applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within 1/2 of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

D. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer’s standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturer’s written instructions.
   1. Color and Gloss: As indicated in Division 09 Section “List of Finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for supporting membrane, blocking, inserts, installation tolerances and other conditions affecting performance.
   1. Canopy manufacturer shall examine surfaces prior to the start of installation. Deviations from the shop drawings shall be brought to the attention of the Contractor at once.

3.2 PREPARATION

A. Aluminum surfaces that are to come in contact with dissimilar materials shall be protected with one coat of asphaltic emulsion paint in addition to factory protection.

3.3 INSTALLATION

A. General: Install coverings at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Use mounting methods of types described and in compliance with shop drawings and fabricator's written instructions.

B. Install covering after other finishing operations, including joint sealing and painting, have been completed.

C. Anchoring to In-Place Construction: Use anchors, fasteners, fittings, hardware, and installation accessories where necessary for securing coverings to structural support and for properly transferring load to in-place construction.

D. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

E. Coordinate coverings installation with flashing and joint sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall and roof assemblies.

F. After installation, entire system shall be left in a clean condition.

END OF SECTION 10 73 26

SECTION 10 14 23.14 – EXTERIOR PANEL SIGNAGE (SECURITY)

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Exterior door letter signs
      a. Reflective signage

B. Related Sections include the following:
   1. Division 10 Section “Dimensional Letter Signage”.

1.2 DEFINITIONS

A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for signs.
   1. Show sign mounting heights and locations.

C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:
   1. Aluminum, painted.
   2. Die-cut reflective characters. Include representative samples of available type and styles.

D. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
   1. Panel Signs: Full size sample.

E. Closeout Submittals:
   1. Maintenance Data: For signs to include in maintenance manuals.
   2. Warranty: Special warranty specified in this Section.

1.4 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering.
      b. Deterioration of colors, and sign lamination.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers: Subject to compliance with requirements, provide signage by one of the manufacturers specified.
   1. Exterior Door Letter signs.
      a. A.R.K. Ramos

b. Matthews International Corp.
c. Metal Arts; Div. of L & H Mfg.
d. Southwell Co.
e. ACE Sign Systems
f. Diskey Architectural Signage
g. Forty-Nine Degrees
h. Jarob
i. Gemini Incorp
j. Dixie Graphics
k. Interior Graphic Systems
l. Ellet Signs

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The "Substitution Request Form" Sample sign, and complete technical data for evaluation must accompany requests for A/E's approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural and Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.3 MATERIALS

A. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated and suitable for exterior applications.

2.4 PANEL SIGNS (EXTERIOR)

A. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils with pressure-sensitive adhesive backing. Reflective at exterior door and exterior window locations.

B. Exterior Door Reflective Signage
1. Exterior door locations: Provide 7-inch square by 0.080 inch thick aluminum sign with a 4 inch high letter, ½" inch wide stroke reflective characters. Provide on the exterior and interior of each exterior door location at a low location and a high location (four signs per exterior door opening). The main front door shall start with the letter "A" proceeding from that door, lettering shall continue around the building to the door to the left as you face Door "A" from the outside of the building.
2. Coordinate in the field with the Architect and Local Authorities with Jurisdiction the exact mounting locations of each sign. The lower door signs shall be mounted no higher than 24 inches above finish floor, unless otherwise requested by authorities with jurisdiction.
a. Provide mounting accessories and offset spacers necessary for mounting signage to smooth metal door or aluminum storefront/window glazing.
b. Locations of these signs are indicated on the signage drawing sheet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs and accessories where indicated, using mounting methods of types complying with manufacturer's written instructions.
   1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
   2. Install exterior door and window signs as indicated.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 23.13

SECTION 11 57 00 - VOCATIONAL SHOP EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Vocational shop equipment indicated on the Drawings, including welding equipment.
   1. Item shall include accessories, fasteners, trim, and related items required to make a fully complete and operating installation.
   2. Provide labor, materials, and equipment necessary for the disconnection, removal, storage, protection, relocation or replacement, and the reconnection of existing equipment as specified in the schedule following this Section.

B. Related Sections include the following:
   1. Division 02 Section “Selective Demolition” for equipment to be salvaged and reinstalled.

1.2 ACTION SUBMITTALS

A. Product Data for Provided equipment (Welding): Shall describe characteristics and specifications of manufactured items showing compliance with Equipment Schedule.
   1. Indicate manufacturer’s model number, technical data, including description of components, booth sizes, accessories and installation instructions.

B. Initial Color Samples: Shall be submitted for surfaces and materials subject to Architect's selection.

1.3 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Maintenance Manuals for new Welding Equipment: Shall be submitted upon completion of installation. They shall include the following:
      a. Parts list and name and address of dealer where parts and service can be obtained.

1.4 QUALITY ASSURANCE

A. Engage an experienced installer to perform the work of this Section who has completed installations similar in design and extent to that indicated for this Project, and who has a record of successful in-service performance.

B. Engage a firm experienced in Welding Workstation assembly similar to that indicated for this Project and with a record of successful in-service performance.

C. Review methods and procedures related to Weld Workstation installation.
   1. Review access requirements for equipment delivery.
   2. Review equipment storage and security requirements.
   3. Inspect condition of preparatory work performed by other trades.
   4. Review structural loading limitations.
   5. Review that all components specified in this Section and related components specified in other Section are accounted for.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Store in original protective packaging and in a dry location.

1.6 COORDINATION

A. Coordinate layout and installation with other work, including light fixtures, fixed equipment and workstations, HVAC equipment, fire-suppression system components and equipment of movement such as overhead devices.

B. Coordinate location and requirements of service-utility connections.

PART 2 - PRODUCTS

2.1 EQUIPMENT, GENERAL

A. See the Vocational Shop Equipment Schedule on the Drawings.

2.2 WELDING EQUIPMENT

A. Basis-of-Design: Lincoln Electric K5664-1 for Prism Exhaust Booth Standalone (Side-by-Side Starter). 230V, 3-phase-one pack.
   1. Plug-and-Play Format: Drop-in welding booth with fume extraction.
   2. Duct-Free Design: No ductwork required. Simply provide power to the unit.
   3. Double Coverage: Captures weld fume in two key locations near the fume source with the fume extraction arm and through the vent hood.
   4. Optimized Air Control: Easy adjust the airflow rate and balance between the arm and hood extraction points.
   5. Components
      a. Product Type: Prism
      b. Style: Extraction booth
      c. Motor Power (HP): 1.5 HP
      d. Input Current (Amps): 6-6.7A
      e. Input Hertz: 50-60Hz
      f. Input Phase: 3
      g. Input Voltage: 208-230V
      h. Duty Cycle: 100%
      i. Sound Level: 65dBA (clean filters, approximately 60% speed), 73dBA (saturated filters, 100% speed)
      j. Air Flow: 1000 CFM split between both extraction sources
      k. Standard Arm Dimensions: 4-6 ft. telescoping arm
      l. Arm Type: Telescoping
      m. Filtration: Fume extraction arm and hooded exhaust vent
      n. Filter Area sq.ft.: 560
      o. Filter Type (MERV rating): MERV 16
      p. Type of Cleaning: None
      q. High Vac or Low Vac: Low Vac

B. Includes
   1. Welding booth walls.
   2. Telescopic counterweight fume extraction arm.
   3. Top-mounted prism fume extraction.
   4. Two MERV 16 disposable filters.
   5. Weld curtain.
   6. Booth lighting.
   7. Extraction unit control panel.

C. Booth Assist: Alert system to monitor student activity. A control panel paired with an easy-to-see tri-colored light stack indicates if the booth is occupied (green), actively welding (amber) or if help if needed (red).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment shall be installed by experienced mechanics familiar with this type of Work.

B. Installation instructions furnished by the manufacturer shall be strictly adhered to.

C. Equipment called for shall be placed in its proper location, uncrated, and assembled ready for use.

D. Anchor equipment into place and in manner indicated on approved shop drawings.

3.2 ADJUSTING AND CLEANING

A. After installation movable components shall be carefully adjusted so that they function properly.

B. Exposed surfaces, edges, and cabinet interiors shall be cleaned and construction and installation marks removed prior to acceptance by Owner.

END OF SECTION 11 57 00

DIVISION 11 EQUIPMENT

SECTION 11 31 00.00 – RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. See Residential Equipment Schedule on the Drawings for acceptable models.

B. Related Sections include the following:
1. Division 22 Section "Domestic Water Piping" for water distribution piping connections to residential appliances.
2. Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" for services and connections to residential appliances.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Meeting: Conduct meeting at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
1. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.
2. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product Schedule: For appliances. Use same designations indicated on Drawings.

B. Field quality-control reports.

C. Sample Warranties: For manufacturer’s special warranties.

D. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.

1.5 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Warranties: Manufacturer’s special warranties.
2. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Waste Management and Disposal: As specified in Division 01 “Construction Waste Management and Disposal” and as follows:
1. Separate corrugated cardboard and other protective materials in accordance with Waste Management Plan and place in designated areas for recycling.
2. Fold up metal banding, flatten, and place in designated area for recycling.

1.7 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 RESIDENTIAL APPLIANCES

A. Refer to the residential appliance schedule on drawings.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for Architect/Engineer's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain each type of residential appliance from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1 <Insert requirement>.

2.3 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

END OF SECTION 11 31 00.00

DIVISION 12

FURNISHINGS

SECTION 12 24 13 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Motor-operated roller shades with single and double rollers.

B. Related Requirements:
   1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
   2. Division 07 Section "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.
   3. Division 09 Section “Gypsum Board Assemblies” for coordination with gypsum ceilings, soffits, and bulkheads.
   4. Division 11 Section “Common Motor Requirements for Equipment” for NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements.
   5. Division 26 Sections for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
   2. Preparation instructions and recommendations.
   3. Installation and maintenance instructions.
   4. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operation instructions.
   5. Storage and handling requirements and recommendations.
   6. Mounting details and installation methods.
   7. Motorized Shade Operators: Include operating instructions.
   8. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Include window opening dimensions, methods of attachment and structural support. Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
   1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring. Indicate motor size, electric characteristics, and mounting arrangements.
   2. Wiring Diagrams: Power, system, and control wiring.

C. Samples for Initial Selection: For each type and color of shadeband material.
   1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of roller shade.
   1. Shadeband Material: Not less than 3 inches square. Mark interior face of material if applicable.
   2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
   3. Installation Accessories: Full-size unit, not less than 10 inches long.

E. Product Schedule: For roller shades. Use same designations indicated on Drawings. Field verify window quantities, type of shade, controls, fabric, and color, and include opening sizes and key to typical mounting details.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material.

C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency. Field verifies window quantities, type of shade, controls, fabric, color, and include opening sizes and key to typical mounting details.

1.4 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
      a. Methods for maintaining roller shades and finishes.
      b. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
      c. Operating hardware.
      d. Motorized shade operator.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

B. Label containers and shades according to Window Shade Schedule.

C. Store products in manufacturer’s unopened packaging until ready for installation.

D. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap and packaging to be returned to manufacturer for recycling into new product.
   2. Separate corrugated cardboard and packaging accordance with Waste Management Plan and place in designated areas for recycling.
   3. Fold up metal banding, flatten, and place in designated area for recycling.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements products that may be incorporated into the work include, but are not limited to, products listed in other Part 2 articles.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests of A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

C. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame-Resistance Ratings: Passes NFPA 701.

B. Product Standard: Provide roller shades complying with WCMA A 100.1.

2.3 MOTOR-OPERATED, DOUBLE-ROLLER SHADES

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
1. Motorized Shade Assemblies
    a. MechoShade Systems, Inc.
    b. Draper Inc.
    c. Lutron Electronics Co. Inc.
    d. Hunter Douglas Contract, Nysan Roller Shades
    e. DFB Sales, Sol-R-Shades
    f. Springs Window Fashions; SWF Contract

B. Motorized Operating Systems: Provide factory-assembled, shade-operator systems of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard tubular, enclosed in rollers.
    a. Electrical Characteristics: 24-V dc.
    b. Maximum Total Shade Width: As required to operate roller shades indicated.
    c. Maximum Shade Drop: As required to operate roller shades indicated.
    d. Maximum Weight Capacity: As required to operate roller shades indicated.

3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for face mounting. Provide the following for remote-control activation of shades:
    a. Group Control Station: Maintained-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for single-switch group control.
    b. Color: As selected by Architect from manufacturer's full range.
4. Limit Switches: Adjustable switches, interlocked with motor controls and set to stop shade movement automatically at fully raised and fully lowered positions.
5. Operating Features:
    a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shades for service.
1. Double-Roller Mounting Configuration: Side by side.
2. Inside Roller:
    a. Drive-End Location: As indicated on Drawings.
    b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Outside Roller:
    a. Drive-End Location: As indicated on Drawings.
    b. Direction of Shadeband Roll: Reverse, from front (interior face) of roller.
4. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

F. Inside Shadebands:
1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    a. Type: Enclosed in sealed pocket of shadeband material.
    b. Color and Finish: As indicated in “List of Finishes”.

G. Outside Shadebands:
1. Shadeband Material: Light-blocking fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    a. Type: Enclosed in sealed pocket of shadeband material.
    b. Color and Finish: As indicated in “List of Finishes”.

H. Installation Accessories:
1. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
    a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches.
2. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.4 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fad resistant.

1. Shade Band Material: PVC coated fiberglass or polyester duplex basketweave with light side and dark side. GREENGUARD Children and Schools certified as a low emitting fabric. Fire rating: NFPA 701.
   a. Openness Factor: 5 percent.
2. Color: As indicated in “List of Finishes”.

C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.
1. Shade Band Material: Polyester-cotton blend, 13.5 oz./sq.yd. min., .025 inches thick mm. Fire rating: NFPA 701. Green Spec. Listed.
2. Color: As selected by A/E from manufacturer’s full range.

2.5 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.

B. Coordinate requirements for power supply conduct, and wiring required for window shade motors and controls.

3.3 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

C. Roller Shade Locations: As indicated on Drawings.

3.4 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

B. Test window shades to verify that operating mechanism, fabric retainer, and other operating components are functional. Correct deficiencies.

C. Test motorized window shades to verify that controls limit switches, interface to other building systems, and other operating components are functional. Correct deficiencies.

3.5 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 12 24 13

SECTION 12 32 16 - MANUFACTURED PLASTIC-LAMINATE-FACED (EDUCATIONAL) CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Plastic laminate faced cabinets of stock design casework, where indicated.
a. This Work includes special and modified stock design preassembled units for installation as movable, fixed, or built-in, as indicated.
b. The use of dimensions and specific requirements set forth in Drawings and Specifications are not intended to preclude the use of other acceptable manufacturer's products or procedures which may be equivalent but are given for purpose of establishing standard of design and quality for materials, construction, and workmanship.
c. Cabinets indicated to receive sinks shall be constructed to allow for installation of sinks of sizes indicated. Coordinate with Division 22 for sink sizes.
2. Casework hardware and accessories.
3. Plastic-laminate countertops.

B. Related Sections:
1. Division 02 Section “Selective Demolition” for removal and relocations of existing casework.
2. Division 06 Section “Miscellaneous Carpentry” for wood blocking for anchoring manufactured wood casework.
3. Division 06 Section “Plastic-Laminate-Faced Architectural Cabinets” for coordination with custom casework.
a. At a minimum, casework scheduled in the same rooms, spaces, or areas shall have coordinated:
1) Plastic-laminate selections.
2) Working surface heights.
3) Edge treatments.
4) Backsplash/endsplash conditions.
5) Hardware finishes.
4. Division 07 Section “Joint Sealants.”
5. Division 09 Section "Gypsum Board Assemblies" for reinforcements in metal-framed partitions for anchoring manufactured wood casework.
6. Division 09 Section "Resilient Base and Accessories" for resilient base applied to manufactured wood casework.
7. Division 12 Section “Wood Countertops” for butcherblock counters.
8. Division 22 Section “Plumbing Fixtures” for sinks.

C. Contractor Option: Unless otherwise noted, Contractor has option of providing either Division 06 Section “Plastic-Laminate-Faced Architectural Cabinets” or Division 12 “Manufactured Plastic-Laminate-Faced (Educational) Casework”. While a mixture complying with referenced standards is permitted, do not mix fabrication methods in individual room or spaces, unless specifically approved by A/E.

1.2 DEFINITIONS

A. General: Definitions in Architectural Woodwork Institutes (AWI) “Architectural Woodwork Quality Standards” apply to the work of this Section, unless otherwise noted herein.

B. MDF: Medium-density fiberboard.

C. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including sides, and bottoms of cabinets more than 48 inches above floor, and tops less than 78 inches above floor. Surfaces that are visible in open cases, or through glass doors or grille doors, shall also be considered to be exposed portions.

D. Semi-exposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches or more above floor are defined as semi-exposed.

E. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

F. Casework includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination
1. Coordinate layout and installation of framing and reinforcements in gypsum board walls and partitions for support of manufactured casework.
   a. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed and indicate measurements on Shop Drawings.
2. Coordinate casework installation with size, location and installation of service utilities. Sequence installation to accommodate required utility connections.

B. Preinstallation Meetings
1. Preinstallation Meeting: Conduct meeting at Project site.
2. Keying Meeting: Conduct meeting at Project site. Incorporate keying meeting decisions into final keying requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:
1. Include plans, elevations, sections, and attachment details.
2. Show fabrication details, including types and locations of hardware.
3. Show installation details, including field joints and filler panels.
4. Show locations and sizes for blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
5. Show locations and sizes of cutouts and holes for items installed in cabinets.
   a. Indicate locations of plumbing and electrical service field connection by others.
6. Countertops; Include:
   a. Plans, sections, details, edge, and backsplash profile, and attachments to other work.
   b. Locations and details of joints.
   c. Locations and sizes of cutouts and holes for items installed in countertop.

C. Samples for Verification: 8-by-10-inch Samples for each type of finish, including top material.

1.5 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS:

A. Qualification Data: For installers.

B. Certification: Letter from particleboard manufacturer certifying materials contain less than 1 percent asbestos by polarized light microscopy (PLM) analysis.

C. Coordination Submittals
   1. Copy same submittals to other trades and other Prime Contractors who have connecting or adjacent works for coordination review and for locating their work connected to or adjacent to the equipment specified herein.
   2. Distribute review “Field Use” copies to all affected trades when casework manufacturer and affected Contractors have completed coordination necessary for complete installation.

1.6 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Warranty: Sample of special warranty.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of educational casework manufacturer for installation and maintenance of units required for this project. The installer must have completed 3 projects of similar size and scope to this project in the last 5 years or a certified participant in AWI’s Quality Certification Program. References of these projects shall be supplied upon request.

B. Materials shall contain less than 1 percent asbestos by content.

C. Composite wood products shall be labeled or show compliance with the Toxic Substances Control Act (TSCA) Title VI.

D. Quality Standard: Unless otherwise indicated, comply with requirements for modular cabinets in AWI's "Architectural Woodwork Quality Standards." Minimum quality standards shall be custom grade in accordance with AWI and additional requirements as specified herein.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver manufactured wood casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

C. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Separate corrugated cardboard and packaging accordance with Waste Management Plan and place in designated areas for recycling.
   2. Fold up metal banding, flatten, and place in designated area for recycling.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install manufactured wood casework until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of construction contiguous with manufactured wood casework by field measurements before fabrication.

1. Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating educational casework without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing then and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of manufactured wood casework that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Delamination of components or other failures of glue bond.
      b. Warping of components.
      c. Failure of operating hardware.
      d. Deterioration of finishes.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   1. Plastic-Laminate-Faced Manufactured Casework:
      a. Case Systems Inc.
      b. Stevens Industries, Inc.
      c. TMI Systems Design Corporation.
      d. Advanced Cabinet Systems.
      e. Southern Cabinetry.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum. Manufacturers shall submit the following items to be considered for approval:
   1. Architectural binder, cut sheets and specifications fully describing proposed products.
   2. List of at least ten projects of similar size, material, design, and extent to that indicated for this Project; whose work has resulted in casework installations with a record of successful in-service performance, including names and phone numbers of Architect and Owner.
   3. Sample of shop drawings produced for similar project.
   4. Sample of casework (base cabinet) complying with specification requirements.

2.2 SYSTEM DESCRIPTION, CASEWORK

A. Quality Standard: Unless otherwise indicated, comply with the AWI’s “Architectural Woodwork Standards” for grades of casework indicated for construction finishes, installation, and other requirements.
   1. Grade: Custom.

B. Accessibility Requirements: Casework shall be provided to conform to the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local Regulations. These requirements supersede Technical Specifications in this Section.

C. Performance Requirements
   1. Casework shall meet or exceed load tests as outlined in ANSI A161.1, unless otherwise noted.
      a. Countertops shall not deflect more than 1/4 inch when a load at 100 pounds per linear foot is applied, unless otherwise noted.
      b. Shelving shall be capable of supporting 25 pounds/sq.ft., unless otherwise noted.

2.3 CASEWORK MATERIALS, GENERAL

A. Low-Emitting Materials: Adhesives and composite wood products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

C. Softwood Plywood: DOC PS 1.

D. Particleboard: ANSI A208.1, Grade M-2 made with binder containing no urea formaldehyde; that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. MDF: ANSI A208.2, Grade 130 Grade 130, made with binder containing no urea formaldehyde; that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers".

F. Hardboard: AHA A135.4, Class 1 Tempered.

G. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

H. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

I. Thermally Fused Laminate (TPL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper complying with requirements of NEMA LD3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

J. Edgebanding for Plastic Laminate:
   1. Plastic laminate matching adjacent surfaces only where indicated. PVC edge-banding, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere.
   2. Barbed T-edging will not be acceptable.

K. Edgebanding for Thermally Fused Laminate (TFL) Panels: PVC or polyester edge banding complying with LMA EDG-1 and matching color and pattern of thermoset decorative panels.

2.4 CABINET DESIGN

A. Type of Construction: Face frame.

B. Design: Provide reveal overlay with wire pulls, unless otherwise noted.

C. Grain Direction for Wood Grain Plastic Laminate

1. Vertical on both doors and drawer fronts, with continuous vertical matching.
2. Lengthwise on face frame members.
3. Vertical on end panels.
4. Side to side on bottoms and tops of units.
5. Vertical on knee-space panels.
6. Horizontal on aprons.

D. Exposed Cabinet Materials:
1. Plastic Laminate:
a. Countertops: 0.048-inch-thick minimum with textured finish and conforming to NEMA HGS standards, unless otherwise noted.
b. Exposed horizontal surfaces except countertops: Nominal 0.028-inch-thick minimum with low-lustre textured finish and conforming to NEMA HGS standards.
c. Exposed interior and exterior vertical surfaces: 0.028-inch-thick minimum with low-lustre textured finish and conforming to NEMA VGS standards.
2. Unless otherwise indicated, provide specified edge treatment on all exposed edges.

E. Semi-Exposed Cabinet Materials:
1. Plastic Laminate: Grade VGS or CLS.
a. Provide plastic laminate for semi-exposed surfaces unless otherwise indicated.
b. Shelves: .028-inch-thick minimum with low luster textured finish and conforming to NEMA HGS standards.
2. Thermally Fused Laminate (TFL) Panels: Thermoset decorative panels may be used for semi-exposed surfaces in lieu of plastic laminate, Grade CLS, as fabricator's option, unless otherwise indicated.
3. Unless otherwise indicated, provide 1mm PVC on all semi-exposed edges.

F. Concealed Cabinet Materials:
1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.
2. Plastic Laminate: Grade BKL, 0.020-inch minimum thickness.

2.5 COLOR AND FINISH

A. Thermally Fused Laminate (TFL) Panel Colors, Patterns, and Finishes: Refer to "List of Finishes".

B. Plastic-Laminate Colors, Patterns, and Finishes: Refer to "List of Finishes".

C. PVC Edgebanding Color: As selected from casework manufacturer's full range.
1. Colors of PVC leading edges:
a. Open Units: Match exterior plastic laminate color.
b. Horizontal and Vertical Front Cabinet Members: Match exposed plastic laminate color or as selected by A/E.
c. Semi-Exposed Locations: Match interior plastic laminate color.
d. Drawer and Door Fronts: As selected from colors to match plastic laminate, or as selected by A/E.

2.6 CABINET FABRICATION

A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:

1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces, unless otherwise noted or as required to meet "Performance Requirements".
2. Shelves:
   a. Exposed Locations: 1-inch thick, vertical grade plastic laminate both sides. Color to match cabinet exterior plastic laminate or as selected by A/E.
   b. Semi-exposed locations: 3/4 inch thick, thermally fused laminate (TFL) panels both sides.
   c. Front and back leading edges shall be edged with flat 1mm thick impact-resistant PVC edging to match shelf color.
   d. Number of adjustable shelves provided, unless indicated otherwise on the Drawings or on the Schedule
      1) Tall cabinets
         3 up to 60 inches — 5 up to 84 inches
         4 up to 72 inches — 6 up to 96 inches
      2) Base cabinets
         1 up to 36 inches
      3) Wall hung cabinets
         1 up to 24 inches — 3 up to 42 inches
         2 up to 36 inches
3. Backs of Cabinets: 1/2-inch particleboard, plastic-laminate faced on exposed surfaces, thermally fused laminate (TFL) panels on semi-exposed surfaces.
4. Drawer Fronts: 3/4-inch particleboard, plastic-laminate faced to match doors.
5. Drawer Sides, Backs, and Bottoms:
   a. Constructed of minimum 1/2-inch particleboard, plywood, hardwood lumber, or high-density fiber board; glued and doweled or dovetail jointed; surfaced with vertical grade laminate or melamine of balanced construction. Bottoms constructed of minimum 1/4-inch tempered hardboard, surfaced to match drawer sides, inset and glued to four sides. Reinforce bottoms on wide drawers with front to back inset stiffeners, 1 at 24-inch-wide drawers, 2 at 36 inch and 4 at 48 inch; glue, fasten, and seal perimeter with hot melt adhesive.
      1) Drawers:
         a) Sides, back and sub front shall be particleboard, 1/2-inch thick, laminated with vertical grade laminate or melamine of balanced construction. The back and sub front shall be doweled and glued into the sides. Dowels shall be fluted, with chamfered ends and a minimum diameter of 8mm.
         b) Drawer bottom shall be particleboard, 1/2-inch thick, laminated with vertical grade laminate or melamine of balanced construction, screwed directly to the bottom edges of the drawer box. Drawer bottom less than 1/2-inch thick will not be permitted.
         c) Paper storage drawers shall be constructed similar except retaining hood shall be included at the rear of each drawer.
6. File Drawers: Construct as specified above. File drawers shall have front-to-back and side-to-side hanger file capability with hanger channel for letter size files integral with file drawer sides. 3/16 inch by 1/2-inch removable steel channel to span side-to-side for legal size hanging files.
7. Doors: 3/4-inch particleboard or MDF, plastic-laminate faced may be provided as fabricator's option to wood drawers.

C. Shop cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.7 CASEWORK HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.
   1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
   2. Hardware shall conform to requirements of ADAAG.

B. Butt Hinges: Stainless Steel, semi-concealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips with non-removable pins fastened with four screws in each leaf. No edge fastening. Provide 2 hinges for doors less than 48-inches high and 3 hinges for doors more than 48-inches high.

C. Pulls: Stainless steel aluminum bent wire style pulls, fastened from back with two screws. For sliding doors, provide recessed powder-coated steel flush pulls. Provide 2 pulls for drawers more than 24-inches wide.

D. Door Catches: Zinc-plated or powder-coated, nylon-roller spring catch, or dual, self-aligning, permanent magnet catches.
   1. Catches shall comply with ADA requirements for pounds of pull required to open doors.
   2. Provide 2 catches on doors more than 48 inches high.
   3. Chain Stops
      a. Install on the following:
         1) Operable doors of tall wardrobe units and cabinets.
         2) Other operable doors that are restricted from swinging 180 degrees.
      b. Length of chain shall allow doors to open 90 degrees minimum.
         1) Exception: Shorten chain if required to prevent door or door handles from hitting obstructions.

E. Drawer Slides: BHMA A156.9, Type B05091.
   1. Regular drawers, knee space and pencil: Epoxy coated steel, bottom corner mounted with smooth quiet nylon rollers.
      a. Positive stop both directions with self-closing feature.
      b. Loading: 100-pound load capacity.
   2. Paper Storage: 150-pound load rated epoxy coated steel slides.
   3. File Drawers: Full extension, epoxy coated steel, bottom corner mounted with smooth and quite nylon rollers.
      a. Positive stop both directions with self-closing feature.
      b. Loading: 150-pound load capacity.

F. Drawer and Hinged Door Locks:
   1. Cam or half-mortise type (disc tumbler), brass with nickel-plated finish; complying with BHMA A156.11. Cams must be permanently attached.
   2. Cabinets to be keyed alike per room, each room keyed differently and master keyed, unless noted otherwise on drawings.
      a. Provide four keys per room and 6 master keys.
   3. Provide locks on all doors and drawers.

G. Adjustable Shelf Supports: Injection molded transparent polycarbonate friction fit into cabinet end panels and vertical dividers, adjustable on 1-inch centers. Each shelf support has 2 integral support pins, to interface pre-drilled holes, and to prevent accidental rotation of support. Support also provides non-tip feature for shelving. Structural load to 1200 lbs. (300 lbs./support) without failure.

A. Grommets for Cable Passage through Countertops: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
   1. Basis-of-Design: Mockett 93P Putty

B. Cubicle cabinet dividers shall be 3/4-inch particleboard with laminate on both sides.

2.8 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.9 COUNTERTOPS, GENERAL

A. Countertops, General: Provide sooth, clean exposed tops and edges in uniform place free of defects. Provide from and end overhang of 1 inch over base cabinets.
   1. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   2. Shop cut openings to maximum extent possible to receive fixtures and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings.
      a. For plastic-laminated clad countertops: Sand edges of cutouts to remove splinters and burrs. Seal edges if openings in countertops with a coat of varnish.

2.10 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with ANSI/AWI 1236 for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.
   1. The Contract Documents may contain requirements that are more stringent than that of the referenced quality standard. Comply with requirements of the Contract Documents in addition to those of referenced quality standard.

B. Plastic-Laminate Tops: Plastic-laminate sheet, shop bonded to both sides of 1-1/8-inch particleboard. Sand surfaces to which plastic laminate is to be bonded.
   1. Plastic Laminate for Flat Tops: ISO 4586-3, Grade HGS, unless otherwise noted.
   2. Plastic Laminate for Backing: Grade BKL.
   3. Edge Treatment: Provide 3-mm PVC edging on front edge of top, on top edges of backsplashes and end splashes, and on ends of tops and splashes.
   4. Use veneer-core plywood made with Type II adhesive or exterior glue particleboard for countertops containing sinks.
   5. Backer Sheet: Provide plastic-laminate backer sheet, ISO 4586-3, grade to match exposed surface, on underside of countertop substrate.
   6. Backsplashes 4-inch high scribable, square set; color matching, and mechanically attached, with endsplashes.
      a. Provide at locations where countertops abut walls and where otherwise indicated.
      b. Backsplashes shall have a moisture-resistant core.
   7. Colors and Patterns: As indicated in “List of Finishes”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of manufactured wood casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.3 CASEWORK INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Install level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using shims as required, using concealed shims. Where manufactured wood casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
   1. Provide removable or false backs for access or concealment of heating or plumbing items.

C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Fasten cabinets to masonry, wood blocking, or reinforcements in walls and partitions with fasteners spaced 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
   1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 inches o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.

D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in walls or partitions. Align similar adjoining doors to a tolerance of 1/16 inch
   1. Fasten through back, near top and bottom, at ends, and not more than 16 inches o.c.
   2. Use toggle bolts at hollow masonry.
   3. Use expansion anchors at solid masonry.
   4. Use No. 10 wafer-head screws sized for 1-inch penetration at wood hanging strips.
   5. Use No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish or toggle bolts through metal backing or metal framing behind wall finish at metal-framed partitions.

E. Fasten cabinets to adjacent cabinets and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI's "Architectural Woodwork Quality Standards".

F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

G. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.4 INSTALLATION OF PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in shop.
   1. Provide cutouts for plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   2. Seal edges of cutouts in plastic-laminate by saturating with varnish.

C. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings. Scribe tops and backsplashes to walls and other adjoining vertical surfaces.
   1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

E. Scribe and cut plastic-laminate-clad countertops to fit adjoining work, refinish out surfaces, and repair damaged finish at cuts.

F. Secure tops to cabinets with Z- or L-type fasteners or equivalent, using two or more fasteners at each front, end, and back.

G. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
   1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

H. Secure backsplashes and end splashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.

I. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.5 CLEANING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by A/E.

END OF SECTION 12 32 16

SECTION 12 36 19 - WOOD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood countertops.

B. Related Sections include the following:
   1. Division 02 Section “Selective Demolition” for removal and relocation of existing casework.
   2. Division 06 Section "Miscellaneous Rough Carpentry” for wood furring, blocking, shims and hanging strips required for installing countertops.
   3. Division 06 Section “Plastic-Laminate-Faced Architectural Cabinets” for cabinets supporting countertops.
   4. Division 07 Section “Joint Sealants”.
   5. Division 12 Section “Educational Casework” for coordination with modular casework supporting countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For wood countertops.
   1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
   2. Show locations and sizes of cutouts and holes for items installed in wood countertops.
   3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples for Verification: For the following:
   1. Lumber for Transparent Finish: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
   2. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished wood countertops.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep finished surfaces of countertops covered with protective covering during handling and installation.

D. Waste Management: As specified in Division 01 Section “Construction Waste Management and Disposal” and as follows:
   1. Separate wood waste in accordance with the Waste Management Plan and place in designated areas for recycling.

1.6 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install wood countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Field Measurements: Where wood countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Established Dimensions: Where wood countertops are indicated to fit to other construction, establish dimensions for areas where wood countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 WOOD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood countertops indicated for construction, finishes, installation, and other requirements.
   1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Grade: Custom.

C. Butcher-Block Countertops: For transparent finish. Fabricated from narrow strips of lumber glued together and arranged for random mix of color and grain.
   1. Wood Species: Red oak.
   2. Strip Thickness: 1-1/2 inches

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood countertop and quality grade specified unless otherwise indicated.
   1. Wood Moisture Content: 5 to 10 percent.

2.3 MISCELLANEOUS MATERIALS

A. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health’s “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers”.

2.4 FABRICATION

A. Fabricate wood countertops to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
   1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of openings in countertops with a coat of varnish.

2.5 SHOP FINISHING

A. General: Finish wood countertops at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Finish Materials: Use finish materials that comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood countertops, as applicable to each unit of work.
   1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood countertops. Apply two coats to end-grain surfaces.

D. Transparent Finish:
   1. Grade: Custom.
   2. Finish: System 5, conversion varnish.
   3. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter in accordance with ASTM D523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition wood countertops to average prevailing humidity conditions in installation areas for not less than 72 hours.

B. Before installing wood countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and application of backpriming.

3.2 INSTALLATION

A. Grade: Install wood countertops to comply with same grade as item to be installed.

B. Assemble wood countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
   1. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut wood countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
   1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches variation from a straight, level plane.
   2. Seal joints between countertop and backsplash, and joints where countertop and backsplash abut walls with sealant specified in Section 079200 "Joint Sealants."

F. Shop Finishes: Touch up finishing after installation of wood countertops.
   1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective wood countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

B. Clean wood countertops on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 12 36 19

SECTION 12 48 26.01 – ENTRANCE CARPET TILE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Entrance carpet tile (ECT).

B. Related Sections include the following:
   1. Division 09 Section “Tile Carpeting” for modular carpet tiles.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Verification: For each type of product indicated.
   1. Size: 8-1/2 by 11 inch square, assembled sections.

1.3 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Maintenance Data: For floor mats to include in maintenance manuals.
   2. Extra Materials: Receipt for extra materials.

1.4 MAINTENANCE MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Entrance Carpet Tiles: Full-size units equal to 5 percent of amount installed for each size, color, and pattern indicated, but no fewer than 10 units.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Waste Management and Disposal: As specified in Division 01 Section “Construction Waste Management” and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap and packaging to be returned to manufacturer for recycling into new product.
   2. Separate corrugated cardboard and packaging accordance with Waste Management Plan and place in designated areas for recycling.
   3. Fold up metal banding, flatten, and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Products: Subject to compliance with requirements, provide one of the products specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of specified product. Requests for A/E's approval must be accompanied by the “Substitution Request Form” and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 ENTRANCE CARPET TILE

A. General: Refer to “List of Finishes.”

B. Entrance Tile; carpet tiles shall be specifically designed for use in entries to reduce the amount of contaminates tracked into occupied space.
   1. Indoor Air Quality (IAQ): CRI IAQ Certification “Green Label Plus”.
   2. Flammability – Radiant Panel Test: Class I, ASTM E648.
   3. NBS Smoke: <450 Flaming Mode, ASTM E662.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, ENTRANCE CARPET TILE

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

END OF SECTION 12 48 13

DIVISION 21

FIRE SUPPRESSION

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Mechanical sleeve seals.
   3. Sleeves.
   4. Escutcheons.
   5. Equipment installation requirements common to equipment sections.
   6. Painting and finishing.
   7. Concrete bases.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Mechanical sleeve seals.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Provide pressure testing per NFPA, state and local codes.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated brass.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      f. Bare piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
      b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
      c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
         1) Seal space outside of sleeve fittings with grout.
   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

N. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

P. Verify final equipment locations for roughing-in.

Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

R. Do not support components of the fire-suppression system from steel roof decks. In locations where structural framing members are not available, provide intermediate structural supports spanning between closest structural framing members.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

END OF SECTION 21 05 00

SECTION 21 10 00 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. The fire protection contract shall include all labor and materials as required for the complete installation of this classification of the Work as hereinafter specified and as shown by all of the accompanying Drawings. The Contractor shall examine all Drawings, including Equipment Drawings and those which are intended primarily for other classifications as such items will be considered a part of the Contract.

C. The materials and workmanship throughout shall be first class in every detail, to the best modern practice. All fixtures shall be first quality of their respective kinds and grades, free from defects, furnished and set up complete in every detail and in accordance with all codes and regulations governing the Work. All piping shall be concealed, unless otherwise distinctly specified or shown on the Drawings.

D. The sprinkler systems shall be zoned on a square foot basis with no zones exceeding 52,000 SF. Each zone shall be provided with all necessary valves, valve tamper switches, water flow alarms, and drains as required by NFPA 13.

E. Provide Knox boxes at the main entrances to the building as indicated on the Drawings.

F. Refer to Section 01230 for Alternates that may affect the Work of this Section.

1.2 SUMMARY

A. This Section includes the following fire-suppression piping inside the building:
1. Wet-pipe sprinkler systems.

B. Related Sections include the following:
1. Division 22 Section "Facility Water Distribution Piping" for piping outside the building.
2. Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.

1.3 SYSTEM DESCRIPTIONS

A. Electrical Contractor shall provide, install, and wire alarm bell on exterior of building that will sound upon flow in the fire protection system.

B. The new building addition and the renovated building areas shall be provided with seismic bracing on all piping mains, cross mains, branch piping and all other system components in accordance with the most currently enforced edition of the International Building Code and the local authority having jurisdiction. The bracing materials and methods and installation shall be done in accordance with the procedures described in the latest, and currently enforced edition of NFPA 13.

1.4 AUTHORITY HAVING JURISDICTION

A. Public Safety
1. Fire Prevention and Building Safety Commission Compliance: Install fire protection systems in accordance with the following codes and local regulations of Fire Marshal.
a. Ohio Building Code currently enforced edition.
b. Ohio Mechanical Code currently enforced edition.

c. Ohio Fire Code currently enforced edition.
d. NFPA 101 Life Safety Systems.
e. NFPA sections listed below.

1.5 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

1.6 ACTION SUBMITTALS

A. Product Data: For the following:
1. Piping materials, including sprinkler specialty fittings.
2. Pipe hangers and supports, including seismic restraints.
3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
5. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
6. Alarm devices, including electrical data.

B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.

1.7 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Welding certificates.

B. Field quality-control test reports.

C. Test Reports and Certificate: Submit test reports and certificates including “Contractor’s Material & Test Certificate for Aboveground Piping” and “Contractor’s Material & Test Certificate for Underground Piping” as described in NFPA 13.

1.8 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer's responsibilities include hydraulic calculations, fabricating, and installing fire-suppression systems. Base calculations on results of fire-hydrant flow test.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

D. The sprinkler designer shall be state certified and meet all NFPA state and local requirements.

1.10 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.11 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INTERIOR FIRE MAIN PIPING

A. General: Provide, at the Contractor's option, pipe and pipe fittings complying with NFPA 13, in accordance with one or a combination of the following listings and as a minimum meet specifications ASTM A53 GR.B, A106 GR.B, A135 GR.B, A795, type E, GR.A.

B. Black Steel Pipe: Threaded Ends; Schedule 40 for all sizes through 2 inches; conforming to ANSI B1.20.1.

C. Black Steel Pipe: Cut Groove Ends; Schedule 40 for 2 inches through 6 inches.

D. Sprinkler Head Pipe Drops: Schedule 40, black steel threaded both ends applies to all exposed structure locations. Sprinkler head drops in ceilings and walls with acceptable mounting support frames may, at the Contractor's option, be flexible braided stainless steel hose sprinkler fittings, Victualic "Vic Flex" AH2 series or equal by FlexHead or approved equal. Flexible sprinkler drops and associated support frames shall be by the same manufacturer. Installation of the flexible drops shall be per manufacturer's requirements. Hydraulic calculations shall include correct equivalent lengths per flexible sprinkler drop type.

E. Manufacturer: Subject to compliance with requirements, provide pipe and fittings of the following:
   1. Allied Tube and Conduit, Division of Grinnell Co.
   2. American Tube and Pipe Co.
   3. Bullmoose Tube Co.
   4. Grinnell Co.
   5. Tyler Gustin-Bacon
   6. Vitaulic
   7. Wheatland Tube Co.

2.3 FITTINGS

A. Cast-Iron Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, Class 250, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

B. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, Class 300, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

C. Ductile – Iron Threaded Fittings: ANSI B16.3, Class 150, Class 300, Standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

D. Steel Fittings: UL listed/FM approved ASTM A106 GR B, ANSI 16.9 or ASTM A234, seamless or welded for welded joints.

E. Grooved Mechanical Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47 Grade 32510 malleable iron; or ASTM A53, Type F or Types E or S, Grade B fabricated steel fittings with grooves or shoulders designed to accept grooved end couplings.

F. Grooved Mechanical Couplings: Consist of UL listed/FM approved ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin locking toggle, or lugs to secure roll-grooved pipe and fittings.

G. Housing: Ductile iron castings (ASTM A636 Grade 65-45-12).

H. Housing: Malleable iron casting (ASTM A47 Grade 32510).

I. Rubber Gasket: Ethylene Propylene Rubber (EPDM) as standard, to ASTM D2000.

J. Bolts – carbon steel track bolt (ASTM A183 Grade 2).

K. Nuts – carbon steel bars (ASTM A283 Grade D).

L. Cast-Iron Threaded Flanges: ANSI B16.1, Class 250; raised ground face, bolt holes spot faced.

M. Cast Bronze Flanges: ANSI B16.24, Class 300; raised ground face, bolt holes spot faced.

2.4 DIELECTRIC FITTINGS

A. Assembly shall be copper alloy, ferrous, and insulating materials with ends matching piping system.

B. Dielectric Unions: Factory-fabricated assembly, designed for 250-psig minimum working pressure at 180 deg F. Include insulating material that isolates dissimilar materials and ends with inside threads according to ASME B1.20.1.
   1. Acceptable Manufacturers:
      a. Capitol Manufacturing Co.
      b. Epco Sales, Inc.
      c. Watts Industries, Inc.; Water Products Div.
      d. Zurn Industries, Inc.; Wilkins Div.

C. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 175-psig minimum working-pressure rating as required for piping system.
   1. Acceptable Manufacturers:
      a. Capitol Manufacturing Co.
      b. Epco Sales, Inc.
      c. Watts Industries, Inc.; Water Products Div.

D. Dielectric Couplings: Galvanized steel with inert and noncorrosive thermoplastic lining and threaded ends and 300-psig working-pressure rating at 225 deg F.
   1. Acceptable Manufacturers:
      a. Calpico, Inc.
      b. Lochinvar Corp.

E. Dielectric Nipples: Electroplated steel with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved ends and 300-psig working-pressure rating at 225 deg F.
   1. Manufacturers:
      a. Perfection Corporation.
      b. Precision Plumbing Products, Inc.
      c. Victaulic Co. of America.

2.5 LISTED FIRE-PROTECTION VALVES

A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Valves shall have 300-psig pressure rating if valves are components of high-pressure piping system.

B. Gate Valves with Wall Indicator Posts:
   1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
   2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with hand wheel, extension rod, locking device, and cast-iron barrel.
   3. Acceptable Manufacturers:
      a. Grinnell Fire Protection.
      b. McWane, Inc.; Kennedy Valve Div.
      c. NIBCO.
      d. Stockham.

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
   1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
   2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
   3. NPS 3: Ductile-iron body with grooved ends.
   4. Acceptable Manufacturers:
      a. NIBCO.
      b. Victaulic Co. of America.

D. Butterfly Valves: UL 1091.
   1. NPS 2 and Smaller: Bronze body with threaded ends.
      a. Acceptable Manufacturers:
         1) Global Safety Products, Inc.
         2) Milwaukee Valve Company.
   2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
      a. Acceptable Manufacturers:
         1) Central Sprinkler Corp.
         2) Global Safety Products, Inc.
         3) McWane, Inc.; Kennedy Valve Div.
         4) Mueller Company.
         5) NIBCO.
         6) Pratt, Henry Company.
         7) Victaulic Co. of America.

E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
   1. Acceptable Manufacturers:
      a. Central Sprinkler Corp.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Grinnell Fire Protection.
      d. Hammond Valve.
      e. Mueller Company.
      f. NIBCO.
      g. Potter-Roemer; Fire Protection Div.

h. Reliable Automatic Sprinkler Co., Inc.
i. Star Sprinkler Inc.
j. Stockham.
k. Victaulic Co. of America.
l. Watts Industries, Inc.; Water Products Div.

F. Gate Valves: UL 262, OS&Y type.
1. NPS 2 and Smaller: Bronze body with threaded ends.
a. Acceptable Manufacturers:
1) Crane Co.; Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) NIBCO.
2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
a. Acceptable Manufacturers:
1) Crane Co.; Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) Milwaukee Valve Company.
4) Mueller Company.
5) NIBCO.
6) Red-White Valve Corp.

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch.
2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
a. Acceptable Manufacturers:
1) Milwaukee Valve Company.
2) NIBCO.
3) Victaulic Co. of America.
3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.
a. Acceptable Manufacturers:
1) Central Sprinkler Corp.
2) Grinnell Fire Protection.
3) McWane, Inc.; Kennedy Valve Div.
4) Milwaukee Valve Company.
5) NIBCO.
6) Victaulic Co. of America.

2.6 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 300-psig pressure rating if sprinklers are components of high-pressure piping system.

B. Acceptable Manufacturers:
1. Central Sprinkler Corp.
2. Firematic Sprinkler Devices, Inc.
3. Globe Fire Sprinkler Corporation.
4. Grinnell Fire Protection.
5. Reliable Automatic Sprinkler Co., Inc.
6. Star Sprinkler Inc.
7. Victaulic Co. of America.
8. Viking Corp.

C. Automatic Sprinklers: With heat-responsive element complying with the following:
1. UL 199, for nonresidential applications.
2. UL 1767, for early-suppression, fast-response applications.

D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
   a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.
   b. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.

E. Sprinkler types, features, and options as follows:
   1. Concealed ceiling sprinklers, including cover plate.
   2. Extended-coverage sprinklers.
   3. Flush ceiling sprinklers, including escutcheon.
   4. Pendent sprinklers.
   5. Quick-response sprinklers.
   6. Recessed sprinklers, including escutcheon.
   7. Sidewall sprinklers.
   8. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Special Coatings: Wax, lead, and corrosion-resistant paint.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

I. Automatic Sprinklers Types and Locations: Provide automatic sprinkler as listed by UL and F.M.
   1. Provide brass upright pendant and side wall sprinklers as required on exposed piping in unfinished spaces.
   2. Provide brass exposed pendant sprinkler heads in finished areas such as storage rooms and janitor closets.
   3. Provide concealed ceiling sprinklers with white cover plate in all finished spaces, unless noted otherwise. **Refer to Architectural Ceiling Plans for locations of black ceilings. Provide sprinklers to match.**
   4. Center heads in ceiling tiles in corridors. All other heads in lay-in ceiling areas shall be in tile to within 4 inches of grid.
   5. Provide wire guards for sprinkler heads in gymnasium.
   6. Provide a higher temperature head in rooms containing kilns. Verify temperature requirements.
   7. Provide factory corrosion resistance coated sprinklers in areas exposed to exterior, pool, freezer/cooler or other corrosive environments.

2.7 HOSE CONNECTIONS

A. Acceptable Manufacturers:
   1. Central Sprinkler Corp.
   2. Elkhart Brass Mfg. Co., Inc.
   3. Grinnell Fire Protection.
   4. Guardian Fire Equipment Incorporated.
   5. McWane, Inc.; Kennedy Valve Div.
   6. Mueller Company.
   7. Potter-Roemer; Fire-Protection Div.

B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include angle pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 1-1/2 or NPS 2-1/2 as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
   1. Acceptable Manufacturers:
      a. ADT Security Services, Inc.
      b. Grinnell Fire Protection.
      c. Potter Electric Signal Company.
      d. Viking Corp.
      e. Watts Industries, Inc.; Water Products Div.

C. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
   1. Acceptable Manufacturers:
      a. Grinnell Fire Protection.
      b. Potter Electric Signal Company.
      c. System Sensor.
      d. Viking Corp.

D. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
   1. Acceptable Manufacturers:
      a. McWane, Inc.; Kennedy Valve Div.
      b. Potter Electric Signal Company.

E. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.
   1. Acceptable Manufacturers:
      a. Potter Electric Signal Company.
      b. System Sensor.

2.9 PRESSURE GAUGES

A. Acceptable Manufacturers:
   1. AGF Manufacturing Co.
   2. AMETEK, Inc.; U.S. Gauge.
   3. Brecco Corporation.
   4. Dresser Equipment Group; Instrument Div.
   5. Marsh Bellofram.
   6. WIKA Instrument Corporation.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.3 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PIPING APPLICATIONS, GENERAL

A. Shop weld pipe joints where welded piping is indicated.

B. Do not use welded joints for galvanized-steel pipe.

C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

D. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with cast- or malleable-iron threaded fittings joints.

E. Underground Service-Entrance Piping: Ductile-iron, mechanical-joint pipe and fittings and restrained joints.

3.5 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13.
      a. Shutoff Duty: Use ball, butterfly, or gate valves.

3.6 JOINT CONSTRUCTION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gauge and comply with ASME B1.20.1.

C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
   1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
   2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
   3. Test each groove for proper depth and width with manufacturers approved tape measure. If groove does not meet the manufacturers requirement, regroove pipe as required.

D. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.

3.7 PIPING INSTALLATION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints.

D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install drain valves on standpipes.

K. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

L. Install alarm devices in piping systems.

M. Hangers and Supports: Comply with NFPA 13 for hanger materials.
   1. Install sprinkler system piping according to NFPA 13.
   2. Provide swivel clamp connections at steel supports as required.
   3. Do not support components of the fire-suppression system from steel roof decks. In locations where structural framing members are not available, provide intermediate structural supports spanning between closest structural framing members.

N. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.

O. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

P. Fill wet-pipe sprinkler system piping with water.

3.8 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:
   1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

3.9 SPRINKLER INSTALLATION

A. Install Schedule 40 steel pipe with threaded joints and fittings for 2 inch and smaller.

B. Install Schedule 40 steel pipe with roll-grooved ends and grooved mechanical couplings for 2-1/2 inches to 6 inches.

C. Comply with requirements of ANSI/NFPA #13 for installation of fire sprinkler piping materials. Install fire sprinkler piping products where indicated, in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that fire sprinkler piping complies with requirements and serves intended purposes.

D. Coordinate with other work including but not limited to plumbing piping, ductwork, equipment, as necessary to interface components of fire sprinkler piping properly with other work.

E. Install supports, anchors, seals, valves, meters, and gauges per NFPA #13.

F. Prior to connecting sprinkler risers for flushing, flush water feed mains, lead-in connections, and control portions of sprinkler piping. After sprinkler piping installation has been completed and before piping is placed in service, flush entire sprinkler system, as required to remove foreign substances, under pressure as specified in ANSI/NFPA #13. Continue flushing until water is clean and check to ensure that debris has not clogged sprinklers.

G. After flushing system, test fire sprinkler piping hydrostatically, for a period of 2 hours, at not less than 200 psi or at 50 psi in excess of maximum static pressure when maximum static pressure is in excess of 150 psi. Check system for leakage of joints. Measure hydrostatic pressure at low point of system.

H. Repair or replace piping system as required to eliminate leakage in accordance with ANSI/NFPA standards. Retest as specified to demonstrate compliance.

I. Sprinkler Head Cabinet and Wrench: Finished steel baked red enamel cabinet, suitable for wall mounting, with hinged cover and space for 12 spare sprinkler heads plus sprinkler head wrench. Provide a separate cabinet for each style sprinkler head on the Project.

J. Piping which passes through a non-sprinklered area shall be adequately protected by fire resistive construction as specified by the Owner and/or code.

K. Cross mains or feed mains which pass through electrical switchgear room(s) shall be double piped (sleeve) unless the pipe is a branch line serving heads in said rooms. Sleeve shall be set in such a manner as to avoid joints in the room. If a joint is required in the room, it shall be a welded joint. Pipe shall be of Schedule 40, black steel. Avoid installing any fire protection piping in electrical rooms, elevator equipment rooms, switch gear rooms unless absolutely necessary. Contact Engineer prior to any of these installations.

L. Drains shall terminate at an open-site drain, or outside of the building. Location of drains to building exterior shall be approved by the Owner/Architect.

M. System main drain shall be piped to the exterior of the building unless noted otherwise.

N. Piping shall not pass through electrical transformer room.

O. In general, sprinkler riser pipe routing has been shown on plans. Integrate sprinkler piping with ducts, lights, diffusers and other mechanical work. All sprinkler head locations shall be integrated with reflected ceiling plans.

P. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. So far as practical, install piping as indicated.
   1. Deviations from approved “Working Plans” for sprinkler piping, require written approval of the authority having jurisdiction. Written approval shall be on file with the Architect prior to deviating for the approved “Working Plans”.

Q. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.

R. Use approved fittings to make all changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

S. There shall be no sprinkler piping or equipment installed within a minimum of 12’-0” of any building wall opening which communicates with the outdoors

3.10 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes, unless otherwise indicated.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 1-1/2 hose-connection valves with flow-restricting device, unless otherwise indicated.

D. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device, unless otherwise indicated.

3.11 HOSE-STATION INSTALLATION

A. Install freestanding hose stations for access and minimum passage restriction.

B. Install NPS 1-1/2 hose-station valves with flow-restricting device, unless otherwise indicated.

C. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow- restricting device, unless otherwise indicated.

D. Install freestanding hose stations with support or bracket attached to standpipe or substrate.

3.12 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

D. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

E. Connect air compressor to the following piping and wiring:
   1. Pressure gauges and controls.
   2. Electrical power system.
   3. Fire alarm devices, including low-pressure alarm.

F. Electrical Connections: Power wiring is specified in Division 26.

G. Connect alarm devices to fire alarm.

3.13 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13

B. This Contractor shall identify all piping installed by him, exposed or concealed, with a marker consisting of an arrow indicating direction of flow and an abbreviation of the service. Piping shall be labeled close to valves, at changes in direction, at branches, at access panels, where pipes pass through the floor before going through the floor), and at entry point into rooms, however, spacing of markers shall not exceed twenty feet. Markers shall be in contrasting color, such as black or white placed conspicuous location subject to approval by the Engineer. The marker shall consist of an arrow, approximately six inches in length with the width to be determined by letter height, and an abbreviation of the service (FL) for Fireline).
The following table of letter sizes shall apply.

Pipe and Covering O.D.	Letter Size
Under 1 inch diameter	1/2 inch
1 inch to 3 inch diameter	1 inch
Over 3 inch diameter	2 inches

3.14 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Energize circuits to electrical equipment and devices.
   4. Start and run air compressors.
   5. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   6. Coordinate with fire alarm tests. Operate as required.
   7. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.15 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

3.16 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 21 10 00

DIVISION 22

PLUMBING

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Plumbing demolition.
7. Equipment installation requirements common to equipment sections.
8. Concrete housekeeping pads.
9. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.
5. Supports and anchorages.
6. Mechanical sleeve seals

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code – Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store PVC plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate with the Division 26 Contractor regarding the location of all Switchboards and Switchgear. Piping shall not be run over or near any Switchboard or Switchgear. Piping foreign to the electrical installation whose malfunction would endanger the operation of the electrical system shall not be routed through the Main Electrical Room, shall not be routed through the Main Emergency Equipment Room, and shall not be routed through the Emergency Generator Room. The exception would be statutorily required fire protection piping.
1. Piping should be avoided over any wall mounted electrical panel with a voltage of 120 volts or higher. Obtain written approval from Owners Representative before routing piping above an electrical panel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:
1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
1. Manufacturers:
    a. Fernco
    b. Mission
2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition and Adaptor Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers:
    a. Fernco
    b. Mission

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.
1. Manufacturers:
    a. Gruvlok
    b. Perfection Corp.
    c. Precision Plumbing Products, Inc.
    d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers:
    a. Calpico, Inc.
    b. Link Seal
    c. Metraflex Co.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With set screw.
1. In Finished Spaces: Polished chrome-plated.

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
1. Finish: Polished chrome-plated.

D. One-Piece, Stamped-Steel Type: With spring clips and chrome-plated finish.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material. Removed shall mean back the branch connections.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment and all associated equipment and apparatuses..
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
      g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with spring clips.
      h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Install sleeves for pipes passing through concrete and masonry walls, foundation walls, and concrete floor and roof slabs.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

O. Verify final equipment locations for roughing-in.

P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   3. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping 2 inches and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping 2-1/2 inches and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom per manufacturer’s recommendations.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

D. Install equipment to allow right of way for piping installed at required slope.

E. If equipment selected is other than the basis of design, and is chosen from the list of acceptable manufactures, the contractor shall be responsible for providing all necessary connections, materials, and serviceability clearance shop drawings for engineers review prior to start of work.

3.6 CONCRETE HOUSEKEEPING PADS

A. Concrete Housekeeping Pads: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete housekeeping pads of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.
   8. All concrete pads shall be 6 inches thick.

END OF SECTION 22 05 00

SECTION 22 05 01 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings prepared for this Project are an outline to show where pipes, ducts, and apparatus must go in order to harmonize with the building and installations of the various trades. Work must be installed in accordance with the Drawings insofar as possible. Drawings shall be carefully checked during the course of bidding and construction. If discrepancies, errors, or omissions are discovered prior to or during the construction phase, notify the Engineer immediately for interpretation or correction. Take necessary measurements and be responsible for same, including clearances for equipment that is to be furnished. The Architect/Engineer shall reserve the right to make minor location changes of piping and equipment where such adjustments are deemed desirable from an appearance or operational standpoint. Such changes will be anticipated sufficiently in advance to avoid extra work or unduly delay progress on the Project.

B. The general building drawings shall be used to obtain dimensions and exact locations and as a check with other Contractors to avoid interferences with their Work. Refer to applicable Drawings on branches of the Work where other trades are involved on the Project so that added field work and job delays resulting from conflicts between crafts can be avoided. Piping or ductwork that is prefabricated before coordinating with the other trades may have to be redone at no additional cost if conflicts are encountered.

1.2 SUMMARY

A. This Section includes the following:
   1. Piping specialties
   2. Lubrication and packing
   3. Installation requirements common to piping systems and equipment specification sections
   4. Disinfecting water lines
   5. Testing and repair
   6. Emergency repairs or operation
   7. Provisions for later installations

B. The Contractor(s) shall provide the labor, materials, equipment, appliances, services and transportation, and perform the operations in connection with the construction and installation of the Work. Work shall be as herein specified and as denoted on the accompanying Drawings.

C. The Contractor(s) shall arrange and pay for permits and inspections required in connection with the Work. The Contractor shall apply for and pay for meters, regulators, recorders, and gauges required. The Contractor must present to the Owner through the Architect/Engineer, properly signed certificates of final inspection by the governing authorities when they become due and shall not cover up Work until approved by those authorities.

C. The Contractor(s) shall make arrangements for connection of the permanent utilities; include connection costs as part of the Work under his Contract. Verify exact requirements of the utility with regard to such service; and include in the Work costs related to same.

D. Materials or labor obviously required to fully complete the Work shall be included, even though each item necessarily involved is not specifically mentioned or shown. Such Work and materials shall be furnished and shall be of the same grade or quality as the parts actually specified and shown. Should there be a conflict between the plans and Specifications, the greater quantity and better quality shall be furnished.

E. Should an overlap of Work between the various trades become evident, the Engineer shall be notified. Such an event shall not relieve the Contractor of the responsibility for the Work called for under his branch of the Specifications until a written clarification or directive is issued concerning the matter.

F. Related Work Specified Elsewhere
1. Firestopping is Work of this Section though fire barrier sealants (firestopping) for walls and floors are specified in Division 07 Section “Penetration Firestopping”. Contractors are responsible for proper sizing of their sleeves and core-drilled holes so that they are at least 1-1/2 inches larger in diameter than the penetrating items. Schedule 40 steel sleeves and core-drilled holes made excessively large or made and not used, will be firestopped and charged to the Contractor who was responsible.
2. Refer to Division 26, Electrical Specifications, and to the requirements stated therein applicable to the Mechanical Work, where coordination of trades is covered.

G. Related Work by Others
1. Motors which are shipped loose from the mechanical equipment shall be installed as Work under Division 26, Electrical, or other trades as may be required, at the expense of the Contractor furnishing the loose motor(s).
2. Unless otherwise stipulated under a specific Section of this Division, motor disconnects and starters shall be provided as Work under Division 26, Electrical.
3. Electric power wiring shall be included as Work under the electrical wiring section of Division 26, Electrical, except as follows:
   a. Control wiring regardless of voltage shall be included as Work under specific Sections of Division 23.
   b. Internal package type wiring as specified under specific Sections of Division 23.

H. Cutting of water lines, electric conduit, or similar service lines in the course of Work performed under this Section shall be immediately repaired as part of the Work of this Section.

1.3 REFERENCE

A. Standards are described by reference to various associations. These are in addition, but not limited to, to those listed in:

AGA	American Gas Association
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Act
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UL	Underwriters' Laboratories, Inc.

B. Work shall be in complete accordance with codes, rules, and ordinances, regulations of authorities, bodies, associations, and governments, having proper or legal jurisdiction. Specifically, the following requirements shall be met in their entirety.
1. State and Local Rules, Regulations, Codes, Statutes, and Ordinances
2. National Fire Protection Association - applicable requirements
3. National Board of Fire Underwriters
4. National Electric Code - applicable requirements
5. Other Codes and Standards as specifically noted in each Section of the Specifications.
6. Americans with Disabilities Act (ADAAG and ICC-A117.1 Applicable edition)

C. References made to codes and standards, in these Specifications or on the Drawings, shall be taken to mean the latest edition, amendment, or revision of such reference in effect as of the date indicated on the Bid Documents unless otherwise noted.

1.4 QUALITY ASSURANCE

A. Instruments used by the Contractor shall be accurately calibrated and maintained in good working condition.

B. Products and test instruments used shall be subject to approval of Architect/Engineer.

C. Products and test instruments used shall be provided by each respective Contractor.

D. Note that systems involved under this Contract heading shall be in accordance with applicable requirements listed in NFPA Standard 90A.

E. Materials used in this Contract shall be those specified herein unless proposals for the use of alternate materials have been submitted and accepted in writing, as provided hereinbefore. Materials shall be strictly first grade of their kind and shall be new and in first-class condition when installed. Damaged materials will be rejected and must be replaced by proper and acceptable materials. Materials shall be similar and in accordance with the provisions of this Specification.

F. No materials or equipment may be installed under this contract heading which do not meet the approval of the authorities having jurisdiction. Specific materials may have certain restrictions or exclusions as to their usage, including where they may not be located. Such regulations shall be adhered to where applicable. The requirements and regulations of the local and state building codes and regulations currently adopted shall be adhered to.

G. Piping systems shall be installed by workmen having skills acquired by working at the trade which is recognized as necessary for competency.

H. Pressure piping systems installed shall conform to the requirements of the State piping and welding codes where applicable.

1.5 PROJECT CONDITIONS

A. Unless otherwise stipulated under a particular heading, the following rules relative to responsibilities of the several Contractors and subcontractors will apply.
   1. Each Contractor shall install roughing-in work pertaining to his trade for connection of Work performed under other Sections of these Specifications.

B. Certain areas will be designated for the storage of materials and equipment and cooperation with the Owner in minimizing interference with existing operations will be mandatory.
   1. Where possible, store materials inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.
   2. Follow manufacturer's instructions for receiving, inspecting, handling, storage, and protection of products prior to final installation

C. Equipment Clearances and Requirements
   1. For many items of equipment described in these Specifications, several manufacturers are listed. The first named in each instance is the make on which the layout was based and on which clearances, service required electrical, and plumbing characteristics, etc., have been checked. Additional manufacturers listed are considered acceptable.

2. Due to the possibility of restrictions imposed by space limitations, the responsibility for resolving conflicts resulting from the use of equipment other than first named shall rest with the equipment supplier and the Contractor. Submittals for this equipment will be considered as a statement that clearances for access, service, maintenance, etc., have been checked and found adequate.
3. Alternate equipment or the equipment of additional manufacturers named in these documents shall meet Base Bid Specifications. In the event such equipment or any equipment which the bidder proposes to furnish, deviates from the requirements of equipment first named regarding electric service, power wiring, control wiring, plumbing or piping, sound attenuation, or vibration damping, it shall be the responsibility of the bidder to include in his price a sufficient sum to cover additional costs or charges resulting therefrom.

D. In general, the piping and ductwork shown on the Drawings shall be considered as diagrammatic for clearness in indicating the general run and connections required, and may not be shown in its true position. The piping and ductwork and equipment may have to be offset, lowered or raised, as required, or as directed at the site in order to accommodate field conditions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 INSTALLATION

A. Lubrication and Packing
1. Rotating and reciprocating equipment requiring lubrication shall be lubricated with the correct grade, type, and quantity of lubricant before being placed in service.
2. Each shaft containing a packing gland shall be checked for condition by backing the packing gland off and examining for proper grade, amount, and type of packing as recommended by the manufacturer. Upgrade to proper standards as required.
3. Maintain lubrication gaskets and packing during construction and assure that at the time of acceptance by the Owner are in first-class operating conditions.

B. Motors, Starters, Controls, and Wiring
1. Alignment of motors, that are factory coupled or mounted and field coupled and mounted, shall be performed by the equipment manufacturer and shall be rechecked after connections have been made and after 48 hours of operation in designed service.
2. Starter/fused disconnects, controls, and wiring shall be coordinated with the appropriate Contractors and completed as required by these Documents.

C. Cutting and Patching
1. Cutting and drilling of walls, slabs, and structural members, required in conjunction with Work under this Section, shall be done under the supervision of the Architect/Engineer. Work shall be neatly done, removing no unnecessary material. Holes, openings, etc., shall be located where they will not weaken the structure. No beams, joists, etc., shall be cut without the written consent of the Architect/Engineer.
2. Cutting of holes in masonry and concrete shall be performed with a core drill to minimize spalling, and limit damage to wall. Locations shall be accurately determined and checked, and the appropriate drill bit shall be used to minimize hole size.
3. Sleeves or thimbles for holes as well as escutcheons and trim plates shall be provided. Installation shall permit free movement of pipe.
4. Patching of work, where necessary, is to be done by a mechanic of the appropriate trade. Unless otherwise noted, patching for Work performed under this Section shall be immediately repaired as part of the Work of this Section.

D. Pipe Sleeves: Install pipe sleeves where piping passes through walls, floors, ceilings, and roofs.

1. Do not install sleeves through structural members of work, except as detailed on Drawings, or as reviewed and approved by Architect/Engineer.
2. Install sleeves accurately centered on pipe runs.
3. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than 2 pipe sizes larger than piping run.
4. Where insulation includes vapor barrier jacket, provide sleeve with sufficient clearance for installation.
5. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves.
6. Extend floor sleeves 1/4 inch above level floor finish, and 3/4 inch above floor finish sloped to drain unless otherwise noted.
7. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.
8. Where insulated piping passes through fire barriers, stop insulation at barrier for fire barrier penetration seal.
9. Where piping passes through nonfire rated, or nonwaterproof, partitions, floors, and walls, apply pipe insulation continuous through pipe sleeves.
10. Do not install sleeves through suspended ceilings.
11. Caulk nonfire rated sleeves with sealant.

E. Protection
1. Provide proper protection to the building during the execution of Work involved under this contract heading.
2. This protection shall include covering apparatus, building surfaces, and other materials to protect same from dirt; adequate temporary connections to protect apparatus from damage and required shielding to protect finished parts of the building. The following shall apply where applicable:
   a. Protect finished floors from chips and cutting oil by the use of metal chip receiving pans and oilproof floor covers.
   b. Protect equipment and finished surfaces from welding and cutting spatters with baffles and spatter blankets.
   c. Protect equipment and finished surfaces from paint droppings, insulation adhesive, and sizing droppings, etc., by use of drop cloths.
3. Pumps, motors, fans, and other rotating/reciprocating equipment stored for this Project shall be adequately protected with openings, bearings, etc., covered to exclude dust and moisture. Stock piled pipe, valves, fittings, etc., shall be placed on dunnage and protected from weather and from entry of foreign material.
4. During installation and until final connections are made, piping shall be protected against entry of foreign matter. Equipment connections shall be carefully sealed until the actual time of system tie-in.

F. Accessibility
1. Provide a union or flange in the piping at each screwed or welded valve, device, or item of equipment, and elsewhere as required for accessibility of repair. Each union shall be so installed as to permit the removal of item without disconnection of any piping except at the union.

3.2 DISINFECTING WATER LINES

A. Disinfect new domestic water service piping and at connections to existing piping in accordance with Local or State Board of Health Regulations. Also follow notes as listed below.
1. Before water system is turned over for use, this Contractor shall have the entire system thoroughly disinfected.

2. Disinfecting shall be by the introduction of a hypochlorite solution of calcium hypochlorite powder containing 65 percent to 70 percent free chlorine, through gravity injection or a suitable pump feeder. Flush throughout the system until approximately 50 P.P.M. is obtained at outlets, faucets, and hydrants. The solution shall stand in the system for 24 hours or more and then be flushed out of lines until not over .2 P.P.M. residual remains.
3. After disinfecting and final flushing, several samples from the various ends of lines shall be drawn and tested by the State or Local Board of Health or Health Authority or an independent laboratory approved by the Department of Health, using their own containers. Such sampling and testing shall be repeated 3 times at 24-hour intervals.
4. Disinfection shall be repeated until the findings of all 3 tests are satisfactory and approved in writing by the official health authority.
5. During the disinfecting period, warning signs shall be posted at each outlet and fixture indicating water should not be drawn or consumed.
6. Furnish Architect/Engineer and Owner with a certificate certifying disinfection was conducted in accordance with the Specifications, together with a report from health authority of the water sample analysis and approval.
7. Additional Disinfection of all water treatment equipment shall be provided as required by AWWA standards and per EPA guidelines.

3.3 TESTING AND REPAIR

A. Upon completion of each respective piping system, but prior to insulating, covering, or backfilling, each system shall be thoroughly cleaned and flushed to remove construction dirt and foreign matter.

B. Test Piping as Specified Herein
1. No piping work shall be concealed or covered until it has been inspected and approved by the project inspector, who shall be notified when the Work is ready for inspection. Work shall be completely installed and tested as required by this Contract and Ordinances of the local Municipality and shall be leaktight to the satisfaction of those making the inspection and the A/E.
2. In general, pressure tests shall be applied to piping. In no case shall piping be subject to pressure exceeding its rating. Defective work shall be promptly repaired or replaced and test shall be repeated until the particular system and component parts thereof receive approval of the A/E.
3. Provide temporary equipment for testing, including pump, blower, and gauges. Test piping system before insulation is installed and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating.
4. Repair piping system sections which fail required piping test by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stopleak compounds, mastics, or other temporary repair methods.
5. Drain test water from piping systems after testing and repair work has been completed.
6. Pressure for Testing of Piping Systems shall be as follows:
   a. Domestic Hot and Cold Water Piping
      1) Piping shall be tested and results approved by Architect/Engineer prior to application of insulation.
      2) Piping system shall be capped and subjected to a static water pressure of 50 psig above operating pressure and a minimum of 125 psig, and pressure maintained for 4 hours with no leaks or loss in pressure.
      3) Test source shall be isolated before conducting pressure tests.
      4) Isolation of tested equipment.
   b. Sewer, Soil, and Waste Piping

1) Soil and waste piping shall be plugged and subjected to not less than a 10 foot head of water. Water column shall be maintained for 2 hours with no leaks.
2) Where subject to freezing, use air or smoke test for not less than 30 minutes and as required by code.

c. Natural Gas Piping
1) Per NFPA #54, state and local utility codes.

d. Fire Protection Piping System (Interior)
1) Per NFPA #13, state and local codes.

7. Accurately record and report methods of testing, times, and dates of test, witnesses to the test, and the results of the test. Test reports shall be neatly typewritten on standard 8-1/2 inch by 11 inch sheets and submitted in 5 copies to Architect/Engineer for approval within 5 days after test has been performed.

C. Damage resulting from tests shall be repaired or damaged materials replaced, to satisfaction of Architect/Engineer, and at no cost to Owner.

3.4 EMERGENCY REPAIRS OR OPERATION

A. The Owner reserves the right to make emergency repairs and protection of the equipment and systems in operation without voiding the Contractor's guarantee bond or relieving the Contractor of his responsibility during the bonding period.

3.5 PROVISIONS FOR LATER INSTALLATIONS

A. Where work cannot be installed as the structure is being erected, the Contractor for such work shall provide and arrange for the building-in of boxes, sleeves, inserts, fixtures, and devices necessary to permit installation of the omitted work during later phases of construction. The Contractor shall arrange for layout, chases, holes, and other openings which must be provided in masonry, concrete, and other work.

B. The Contractor shall be responsible for becoming informed of the nature and arrangement of the materials and construction to which his work attached or passes through.

END OF SECTION 22 05 01

SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

D. The contractor shall coordinate all Division 22 motor locations, quantities and electrical characteristics with corresponding electrical drawings and verify that connections for motors are indicated on the electrical drawings during the bid phase of the project and notify engineer if discrepancies exist.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 22 05 13

SECTION 22 05 19 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Thermometers.
2. Gauges.
3. Test plugs.

B. Related Sections:
1. Division 22 Section "Facility Water Distribution Piping" for domestic and fire-protection water service meters outside the building.
2. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
3. Division 23 Section "Facility Natural-Gas Piping" for gas meters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

PART 2 - PRODUCTS

2.1 METAL-CASE THERMOMETERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Ashcroft
2. Palmer - Wahl Instruments Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments
6. Winters Instruments

B. Case: Die-cast aluminum, 4-1/2-inch diameter.

C. Window: Glass.

D. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

E. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

F. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 THERMOWELLS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
1. Ashcroft
2. Palmer - Wahl Instruments Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments
6. Winters Instruments.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.3 PRESSURE GAUGES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
1. Ashcroft
2. Palmer - Wahl Instruments Inc.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments
6. Winters Instruments.

B. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.
1. Case: Dry type, cast aluminum metal, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, 1/4 inch, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass.
8. Ring: Metal.
9. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
10. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gauge Fittings:
1. Valves: 1/4 inch brass or stainless-steel needle type.
2. Snubbers: ASME B40.5, 1/4 inch brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install thermometers in the outlet of each domestic, hot-water storage tank, thermostatic mixing valves, inlet hot water return pump, all balancing stations indicated on the plumbing drawings and on the incoming water domestic water service just upstream of the water meters.

B. Provide the following temperature ranges for thermometers:
1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.

3.2 GAUGE APPLICATIONS

A. Install dry-case-type pressure gauges for discharge of each inlet and outlet pressure-reducing valve, inlet and outlet of the reduced pressure backflow preventer, on the inlet and outlet of the water heater tank(s), upstream and down stream of the domestic water meters, on the inlet and outlet of the water softener(s), on the inlet and outlet of thermostatic mixing valves, the inlet and outlet of domestic hot water recirculating pumps and each hot water return balancing station indicated on the plumbing drawings.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees where thermometers are indicated.

C. Install direct-mounting pressure gauges in piping tees with pressure gauge located on pipe at most readable position.

D. Install needle-valve and snubber fitting in piping for each pressure gauge.

E. Install thermometers and gauges adjacent to machines and equipment to allow service and maintenance for thermometers, gauges, machines, and equipment.

F. Adjust faces of thermometers and gauges to proper angle for best visibility.

END OF SECTION 22 05 19

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Ball valves.
2. Butterfly valves.
3. Check valves.

B. Related Sections:
1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. This Specification is based on products as manufactured by Milwaukee Valve Company. Equivalent products as manufactured by Crane Co. - Valve Division, Metraflex, Nibco Inc., Nexus, Griswold, Hammond Valve Co., Conbraco, Apollo, Viega and Watts are acceptable. For grooved end butterfly valves use Victaulic, Anvil-Gruvlok, Tyco-Grinnell Mechanical Products, or Nibco.

2.2 BALL VALVES

A. Two Piece Ball Valves 2 inches and Smaller: 600 WOG, 150 SWP, cast bronze body, ASTM B-584, B-62 or B61 teflon seats, full port, blow-out proof stem, adjustable packing gland, stainless steel ball and stem, threaded, solder ends, or press fit ends.

B. For domestic interior plumbing water piping:

1. Threaded Ends 2 inches and Smaller: Class 150, full port, bronze ASTM B 584 B61 or B-62. No forged brass containing more than 15 percent zinc, 2 piece body, Stainless steel ball and stem.
2. Soldered Ends 2 inches and Smaller: Class 150, full port, bronze ASTM B 584 B61 or B-62. No forged brass containing more than 15 percent zinc, 2 piece body, Stainless steel ball and stem.

2.3 BUTTERFLY VALVES

A. Comply with MSS SP-67. Where butterfly valves are used as shutoffs for terminal or equipment removal or repair, provide lug type valves and provide wafer type valves for other applications. Valves shall be NSF approved.

B. Butterfly Valves 3 inches and Larger: Lug type body, extended neck, 200 PSI conforming to ASTM A126, Class B, cast iron, EDPM cartridge liner, aluminum bronze disc, 416 stainless steel stem. Sizes up to 6 inch lever operated, sizes 8 inches and larger gear operated. All butterfly valves shall be suitable for bidirectional dead end service without the need for downstream flange.

C. Grooved End 3 inches and Larger: Ductile iron or ASTM A536 for body and disc, disc to be encapsulated with a elastomeric coating, Grade "E" EPDM, working pressure of 300 psi, bubble tight.

2.4 CHECK VALVES

A. Comply with MSS SP-71 for design, workmanship, material, and testing. Construct pressure containing parts of valves as follows:

B. Swing Check Valves 2 inches and Smaller: Class 150, 300 PSI WOG, cast iron bronze body and cap conforming to ASTM B62. Valves shall be swing type design, threaded, press-fit or solder ends.

C. Swing Check Valves 2-1/2 inches and Larger: Class 125, 200 PSI WOG, cast iron body, bronze trim and bolted cap conforming to ASTM A126, Class B. Flanged ends, swing type disk.

D. Grooved Grooved End 2-1/2 inches and Larger: Ductile iron body to ASTM A536, elastomeric encapsulated disc, Grade "E" EPDM, type 416 stainless steel shaft, nonslamming spring of 304 stainless steel, working pressure of 300 psi.

E. Unless a composition disc is specified, swing check valves 2 inches and smaller shall be bronze, regrinding, with seating angle 40 to 45 degrees. A stop plug is required as a renewable stop for the hanger, unless otherwise specified. Disc and hanger shall be separate parts, and the disc shall be free to rotate. Hanger pins shall be supported on both ends by removable side plug(s).

F. Lift Check Valves 3 inches and Smaller: Bronze or forged steel, to suit the service.

G. Check Valves 4 inches and Larger: Flanged, swing type, unless otherwise specified.

H. For Pump Discharge and Condensate Return Lines:
1. Threaded Ends 2 Inches and Smaller: Class 125, bronze body, screwed cap, spring activated lift check.
2. Flanged Ends 2 1/2 inches and Larger: Class 125, iron body bronze mounted, bolted cap, dual door wafer silent check.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Provide a line size main gate valve on the incoming domestic water service where it enters the building at a point +/- 6” above finished floor and upstream of the domestic water meters.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 22 05 23

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Fastener systems.
   5. Pipe stands.
   6. Equipment supports.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.

1.2 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Sway Bracing: Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for pipe sizes 4 inches and larger.

D. Anchorage shall be provided to restrain drainage piping (storm and sanitary) from axial movement. For pipe sizes greater than 4 inch restrains shall be provided for drain pipes at all changes in direction and at all changes in diameter greater than two pipe sizes.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Pipe positioning systems.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Anvil International, Inc., Portsmouth, New Hampshire. Subject to compliance with requirements, provide either the product named or a comparable product by one of the other manufacturers specified.
   1. Manufacturers:
      a. Copper B-Line, Inc., Highland, Illinois
      b. Erico International Corp., Salon, Ohio
      c. PHD Manufacturing, Columbiana, Ohio

d. Gripple (for aircraft cable), Batavia, Illinois
e. Amber Booth, Houston, Texas
f. Holdrite (for drainage piping restrains)
g. Globe Pipe Hanger Products, Inc.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for Architect/Engineer's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PIPE HANGERS AND SUPPORTS

A. Beam Clamps: Anvil C-Clamp with retaining clip, Fig. #87 for 3/8 inch to 3/4 inch diameter rod.

B. Beam Clamps: Anvil forged steel beam clamp with upper nut, Fig. #228 for 5/8 inch to 7/8 inch diameter rod.

C. Beam Clamps: Anvil Fig. #227 for 3/8 inch and 1/2 inch diameter rod (attachment to top members of angle iron trusses or to top flanges of I-Beams).

D. Hanger Rod: Carbon steel material of size/diameter required, threaded one end, both ends, and/or continuous thread. Provide threaded swivel connections to maintain the threaded rod in a vertical position. Bending threaded rod is not acceptable.

E. Trapeze Type Hangers: Use structural angle, channel, beams, unistrut or equivalent support and/or framing. Provide proper attachment for service listed below.

F. Pipe Attachment: Anvil split pipe ring Fig. #108 and turnbuckle adjuster Fig. #114 (for pipe size 3/8 inch to 8 inch, noninsulated).

G. Pipe Attachment for Hot and Cold Service: Anvil adjustable clevis Fig. #260 for 1/2 inch to 30 inches noninsulated, stationary pipe lines. Size Clevis for outer insulation diameter. Provide with galvanized insulation shield Fig. #167.

H. Pipe Attachment for Independent Support of Hot Service: Anvil Fig. #181, (2-1/2 inch to 20 inch pipe insulated) adjustable steel yoke pipe roll.

I. Trapeze supported for hot and cold service 2 inch to 12 inch insulated Anvil Fig. #175 pipe roll. Roller sized for insulated diameter.

J. Copper tubing 1/2 inch to 2 inch: When attached directly to copper piping or tubing, hangers shall be equipped with permanently attached factory liner of high compression factor, chemically treated to resist moisture, abrasion, heat, cold, and vermin. Liner shall be felt or equally approvable material, or hangers shall be equal to copper plated Anvil Fig. # CT-99. Lined or plated hangers not required when hanger is oversized to cover an insulated line.

K. Pipe Attachment: Anvil adjustable clevis for storm sanitary and vent Fig. #260, for 4 inch to 24 inch pipe. Size for insulation as required. Provide galvanized insulation shield Fig. #167.

L. Pipe Attachment: Anvil adjustable clevis for insulated, steel hot pipe, Fig. #300, for 3/4 inch to 2 inch pipe size.

M. Pipe Attachment: Anvil riser clamp Fig. #261 (for either insulated or bare steel pipe, cast iron or conduit) or Fig. #261c (for glass, copper, brass and/or aluminum pipe), for 3/4 inch to 20 inches and 3/4 inch to 6 inches respectively

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. Pipe attachments shall be located adjacent to fittings at each offset or change in direction, at ends of branches over 5 feet long, at riser pipes, and along piping where necessary to prevent sags, bends, or vibration. Piping risers shall be supported at each floor level.

B. No pipe will be hung from another pipe or pipes.

C. Hanger rod must hang perpendicular before and after pipe covering or insulation is applied.
1. Support piping from rolled steel beams or channels from any point on either top or bottom flanges.
2. Support piping from open web steel joists from hangers connected to either top or bottom chords within 3 inches of center of chord panel points (intersection of diagonal or vertical chord with top or bottom chord). Joist reinforcement will be required if hangers are not installed at panel points. Refer to structural details.
3. In addition to maximum spacing of hangers or supports specified below, the number and spacing of hangers and supports shall be such as to equally distribute loads to all structural members in the system.
4. Connections to structural members shall be clamping devices which do not damage or deform structural elements. Welding to or drilling holes in structural members is not permitted unless specifically approved by Architect.
5. Hanger rods cannot be bent.

D. The maximum horizontal spacing between hangers or supports, measured along the piping for steel pipe, shall be as follows:

Pipe Size	Rod Diameter	Maximum Spacing*
Up to 1-1/4 inch	3/8 inch	8 feet
1-1/2 inch and 2 inch	3/8 inch	9 feet
2-1/2 inch and 3 inch	1/2 inch	10 feet
4 inch and 5 inch	5/8 inch	12 feet
6 inch	3/4 inch	12 feet
8 inch	7/8 inch	12 feet

*Provide hangers on all sides of valves, strainers, elbows, tees, check valves, etc.

E. The maximum spacing between hangers or supports, measured along the piping for plastic DWV pipe, shall be 4 feet on center and, at end of branches change in direction and trap arms, 3 feet or greater.

F. The maximum horizontal spacing between hangers or supports, measured along the piping for copper tubing, shall be as follows:

Nom. Tubing Size	Rod Diameter	Maximum Spacing
Up to 1 inch	3/8 inch	5 feet
1-1/4 inch and 1-1/2 inch	3/8 inch	8 feet
2 inch	3/8 inch	8 feet
2-1/2 inch	1/2 inch	9 feet
3 inch and 4 inch	1/2 inch	10 feet
6 inch	1/2 inch	12 feet

H. Where vertical support locations are not indicated on the Drawings, support cast iron soil pipe, steel, and copper pipe at every floor. Use friction clamps anchored to building construction with not less than two-point bearing.

I. Where several pipes occur at the same elevation, trapeze type hangers may be used. For parallel runs, use unistrut or equivalent capped pipe and approved supports and/or framing. The following general rules shall be followed for attachment:

1. Uninsulated steel piping, use clamps. For copper tubing, the clamps shall be copper plated or lined.
2. Insulated piping 2 inches and smaller, use 18 gauge galvanized steel shield over the insulation in 180 degree segments, minimum 12 inches long with clamp.
3. Insulated piping 2-1/2 inches and larger, use pipe covering protection saddle with roller supports.
4. Cold water piping 2-1/2 inches and larger, use hard block nonconducting type saddles in 90 degree segments and minimum 12 inches long.
5. In tunnels, and where piping is racked on multiple hangers supported with the use of prefabricated structural support channels, the piping attachments shall be as specified for trapeze hangers.
6. Trapezing is not allowed for 8 inch diameter and larger pipes. These pipes must be supported individually.
7. The load on the end of any trapeze shall not be greater than 600 pounds when supported from steel open web joists and 1000 pounds when supported from rolled beams.

J. Hangers for pipe shall be of a compatible material or coating. Where pipe insulation is continuous through hangers, insulation blocks shall be of compressed insulation material of the same thickness as the specified covering and will be equal to or larger in size than the metal insulation protector saddle specified to be installed. Hangers will be isolated from dissimilar metal unless they are of a compatible material.

K. Continuous threaded rod may be used wherever possible. No chain, wire, or perforated strap shall be used. Threaded rod may not be bent. Threaded swivel connections shall be utilized for attachment to sloping structure.

L. Hanger rod shall not be supported from the second floor, mezzanine or the roof deck.

M. Clamp connection on sloped structure shall be provided with swivels so threaded pad will hang vertically.

END OF SECTION 22 05 29

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Ceiling tags.
   5. Valve tags.
   6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Brady USA

B. 3M

C. Seton

D. Connecticut

E. Bran Ford

2.2 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 inches by 3/4-inch.
   3. Minimum Letter Size: 1/4-inch for name of units if viewing distance is less than 24 inches, 1/2-inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   4. Fasteners: Stainless-steel rivets.
   5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch thick, and having predrilled holes for attachment hardware.
   2. Letter Color: White.
   3. Background Color: Red.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 inches by 3/4-inch.
   6. Minimum Letter Size: 1/4-inch for name of units if viewing distance is less than 24 inches, 1/2-inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2 by 11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 inches by 3/4-inch.

F. Minimum Letter Size: 1/4-inch for name of units if viewing distance is less than 24 inches, 1/2-inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe Label Contents: Include identification of pipe service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.
3. Included piping labels are cold water, hot water, hot water return, sanitary, storm, and gas.

2.5 CEILING TAGS

A. Additional location and identification of plumbing system valves shall be accomplished using 1/2 inch diameter colored, pressure-sensitive, adhesive circles. Apply circles to ceiling grid below location of system valves per following color code:

Domestic Cold Water = Blue
Domestic Hot Water = Red

2.6 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

B. Valve Schedules: For each piping system, on 8-1/2 by 11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be located on the Plumbing Drawings.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size: 4 inches by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands on each piping system.
   1. Identification Paint: Use for contrasting background.
   2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:
   1. Low-Pressure, Compressed-Air Piping:
      a. Background Color: Blue.
      b. Letter Color: White.
   2. Medium-Pressure, Compressed-Air Piping:
      a. Background Color: White.
      b. Letter Color: Black.
   3. Domestic Water Piping:
      a. Background Color: Green.
      b. Letter Color: White.
   4. Sanitary Waste and Storm Drainage Piping:
      a. Background Color: White.
      b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
      a. Cold Water: 2 inches, round.
      b. Hot Water: 2 inches, round.
      c. Low-Pressure Compressed Air: 2 inches, round.
      d. High-Pressure Compressed Air: 2 inches, round.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulation Materials for Piping and Equipment:
      a. Provide the labor, materials, equipment, appliances, services and transportation, and perform operations in connection with the construction and installation of the Work. Work shall be as herein specified and as denoted on the accompanying Drawings.

B. Related Sections include the following:
   1. Division 23 Section "HVAC Insulation."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   4. Detail application of field-applied jackets.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

B. Insulation shall meet the latest requirements of ASHRAE 90.1.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Insulating and covering materials have been selected on the basis of mechanical strength, sound transmission characteristic, durability under adverse conditions, vapor impermeability, and appearance, in addition to thermal insulating value. Materials of lesser performance than specified or materials of less thickness than specified, will be ordered removed and replaced with acceptable materials.

B. The use of wheat paste, in lieu of lagging adhesives specified, is absolutely forbidden. Vapor barriers on cold surfaces and piping must be continuous through sleeves, hangers, supports, etc. Stapling of vapor barrier jackets shall be permitted only if staples are sealed with an approved vapor barrier mastic or vapor barrier tape. Maintain the vapor barrier seal throughout each system. No clips or other attachments shall be used that require the perforation or puncturing of any duct or plenum panel. The Insulating Contractor is hereby notified that any duct or panel found punctured or penetrated by clips, screws, or any other device for holding insulating materials, even though penetration is not complete, shall be removed and replaced with new duct or panel at his expense.

C. Protection of Insulation: In general, it is intended that insulation located in areas subject to damage such as mechanical equipment rooms, combined traffic and pipe tunnels or crawl space, and the like, shall be of a dense material to eliminate the possibility of physical damage. Piping insulation installed below 10 feet above finish floor in unfinished spaces shall be protected with an aluminum jacket or PVC pipe cover.

D. Vapor Barriers - General: Vapor barrier facings shall have a maximum flame spread rating of 25 and smoke developed rating not exceeding 50.

E. Flame Spread and Smoke Ratings: Components of the insulation for piping, including coverings, mastics, and adhesives shall have a flame spread rating of not over 25 and the smoke development rating of not over 50. Rating shall be established by tests conducted in accordance with ASTM E84 - Surface Burning characteristics of building materials, NFPA 255 - Surface burning characteristics of building materials, and UL 723 - Surface burning characteristics of building materials.

F. Jacketing: It is imperative that the jacketing used throughout the systems shall have the flame spread ratings and smoke development ratings herein specified as a maximum limit. Where canvas is required to be used as jacketing, the Contractor must include the cost in his bid for finishing with suitable mastics, finishing coats, etc., as required to provide fire resistance.

2.2 PIPE INSULATION

A. This Specification is based on products as manufactured by Johns-Manville. Equivalent products as manufactured by Knauf Fiberglass, Nomaco, CertainTeed, and Owens-Corning Fiberglas Corp are acceptable. The following are acceptable manufacturers for elastomeric foam insulation - Rubatex Corp., Armstrong and IMCOA.

B. Type A; Glass Fiber: Johns-Manville Micro-Lock meeting ASTM C547; Class 1, rigid molded, nonflammable.
   1. “K” Value: 0.23 at 75 deg F.
   2. Maximum Services Temperature: 850 deg F.

3. Vapor Retarder Jacket: AP-T PLUS White kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or AP jacket with outward clinch expanding staples or vapor barrier mastic as needed.

C. Type B; Hydrous Calcium Silicate: Johns-Manville Thermo-12/Blue ASTM C553; Type 1; rigid molded pipe; asbestos-free coded throughout material thickness and maintained throughout temperature range.
1. “K” Value: 0.40 at 300 deg F.
2. Maximum Service Temperature: 1200 deg F.
3. Compressive Strength (block): Minimum of 160 psi to produce 5 percent compression at 1-1/2 inch thickness.
4. Tie Wire: 16 gauge stainless steel with twisted ends on maximum 12 inch centers.

D. Type C; Elastomeric Foam: Rubatex R-180-FS/R-1800-FS meeting ASTM C534; flexible, cellular elastomeric, molded or sheet. Equivalent products as manufactured by Armacell LLC are also acceptable.
1. “K” Value: 0.23 at 75 deg F.
2. Maximum Service Temperature: 220 deg F.
3. Maximum Flame Spread: 25.
4. Maximum Smoke Developed: 50 (3/4 inch thick and below)
100 (above 3/4 inch thick)
5. Connection: Waterproof vapor retarder adhesive as needed; Rubatex R-373 Adhesive.
6. UV-Protection: Outdoor protective coating; Rubatex 374 Coating. Equivalent products as manufactured by Armacell LLC are also acceptable.
7. Insulated piping exposed outdoors shall be covered with a 0.016-inch aluminum jacket with each end and all seams sealed to protect from moisture and Ultra-violet exposure.

E. Type D; Cellular Glass: ASTM C552; "k" value of 0.35 at 75 degrees F; 8.0 lb/cu ft density.

F. Field Applied Jackets:
1. Indoor, exposed applications and mechanical equipment Rooms. PVC Plastic: Johns-Manville Zeston 2000. One piece molded type fitting covers and jacketing material, gloss white.
a. Connections: Tacks; pressure sensitive color matching vinyl tape.
2. Indoor concealed application canvas jacket: UL listed fabric, 6 oz/sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive.
3. Exterior Applications Aluminum Jacket: 0.016-inch thick sheet, (smooth) finish, with longitudinal slip joints and 2 inch laps, die shaped fitting covers with factory attached protective liner.
4. Buried Piping: Provide factory prefabricated pre-insulated assembly with inner polyurethane foam insulation. Outer surface faced with PVC jacket.

2.3 EQUIPMENT INSULATION

A. This Specification is based on products as manufactured by Johns-Manville. Equivalent products as manufactured by Knauf Fiberglass, CertainTeed, Owens-Corning Fiberglas Corp., Rubatex, Armacell LLC, Nomaco, Accessible Products are acceptable.

B. Type E; Flexible Fiberglass Blanket: Johns-Manville 812 Spin-Glas meeting ASTM C612; flexible.
1. "K" Value: 0.24 at 75 degrees F.
2. Maximum Service Temperature: 450 degrees F.
3. Density: 1.5 lb/cu ft density.
4. Vapor Retarder Jacket: Aluminum foil reinforced with fiber glass yarn and laminated to fire-resistant kraft, secured with UL listed pressure sensitive tape and/or outward clinch expanding staples and vapor barrier mastic as needed.

C. Type F; Rigid Fiberglass Board: Johns-Manville 814 Spin-Glas meeting ASTM C612; rigid.
1. "K" Value: 0.23 at 75 degrees F.
2. Maximum Service Temperature: 450 degrees F.
3. Density: 3.0 lb/cu ft density.

4. Vapor Retarder Jacket: Aluminum foil reinforced with fiber glass yarn and laminated to fire-resistant kraft, secured with UL listed pressure sensitive tape and/or outward clinch expanding staples and vapor barrier mastic as needed.
5. Facing: 1 inch galvanized hexagonal wire mesh stitched on one face of insulation (optional).

D. Type G; Rigid Fiberglass Board: Johns-Manville 1000 Spin-Glas meeting ASTM C612; rigid, noncombustible.
1. "K" Value: 0.23 at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Density: 3.0 lb/cu ft density.
4. Facing: 1 inch galvanized hexagonal wire mesh stitched on one face of insulation (optional).

E. Type H; Elastomeric Foam: Rubatex R-180-FS/R-1800-FS meeting ASTM C534; Type II; flexible, cellular elastomeric, molded or sheet. Equivalent products as manufactured by Armacell LLC are also acceptable.
1. "K" Value: 0.23 at 75 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Maximum Flame Spread: 25.
4. Maximum Smoke Developed: 50 (3/4 inch thick and below)
100 (above 3/4 inch thick)
5. Connection: Waterproof vapor retarder adhesive as needed; Rubatex R0373 Adhesive.
6. UV-Protection: Outdoor protective coating; Rubatex 374 Coating. Equivalent products as manufactured by Armacell LLC are also acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

B. Insulate instrument connections for thermometers, pressure gauges, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

C. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

C. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 PIPING INSULATION, GENERAL

A. Items Not Insulated: Unless otherwise indicated, do not install insulation of the following:
1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

B. Insulation shall extend through all hangers and shall not be interrupted by any clamps.

3.10 PIPING INSULATION SCHEDULE

	Type "A"	Type "C"

Piping Service	Type	Pipe Size	Insulation Thickness	Insulation Thickness
Domestic Hot Water Supply (Above Ground)	A or C	All	1"	1"
Domestic Hot Water Recirculating (Above Ground)	A or C	All	1"	1"
Domestic Cold, Soft Cold, Tempered Water and Trap Primer Water piping Supply (Above Ground)	A or C	All	1"	1"
Chilled Drinking Water	A or C	All	1"	3/4"
Above Ground Horizontal Roof Conductor and Overflow Drain Piping from Roof or Overflow Drain to First Vertical Offset	A or C	All	1"	3/4"
Roof Drain Bodies	A or C	All	1"	3/4"
Floor Drain Bodies and Piping from Floor Drains receiving Condensate from Cooling Coils (Above Grade Horizontal Piping only back to its branch connection)	A or C	All	1”	3/4"
Copper Condensate Drain Piping from Cooling Coils	A or C	All	1"	1/2"
Roof Drain/Overflow Drain and Horizontal Storm Piping above Ceiling	A or C	All	1”	3/4”

Notes:
1. Vapor barrier is not required for elastomeric foam insulation.
2. Vapor barrier and waterproof adhesive are required for Type A glass fiber piping insulation.

3.11 EQUIPMENT INSULATION SCHEDULE

Equipment Type	Insulation Type	Thickness	Notes
Domestic Hot Water Storage Tank	H	3/4"	2 layers
Water Storage Tank	H	3/4"	
Softener Mineral Tank	H	3/4"	
Domestic Water Expansion Tank	E or F	1"	

END OF SECTION 22 07 00

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes domestic water piping and water meters inside the building.

B. Water meters will be furnished and installed by utility company.

C. Water meters will be furnished by utility company for installation by Contractor.

D. Related Sections include the following:
1. Division 22 Section "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and fittings.
2. Division 22 Section "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.
3. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.2 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings and water meters, if provided by the Contractor.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER (COLD WATER, HOT WATER, HOT WATER RETURN, SOFT COLD WATER, TEMPERED WATER, TRAP PRIMER WATER)

A. Piping shall be copper tube complying with ANSI/ASTM B88, Type “L” (above floor) and Type “K” (below floor). Fittings shall be wrought copper, solder-joints conforming to ANSI B16.22 or mechanical press-fit.

B. Victaulic, Anvil-Gruvlok, or Tyco-Grinnell Mechanical Products grooved copper connection may be used for -30 deg F to 230 deg F water service. Coupling shall be Victaulic Style 606, Anvil-Gruvlok Figure No. 7400, or Tyco-Grinnell Mechanical Products No. 772, with Type "E" EPDM gasket. Coupling housing shall be ductile iron conforming to ASTM A536. Fittings 2 through 4 inches shall be wrought copper conforming to ASTM B75, alloy C12200. Fittings 5 and 6 inches shall be cast bronze conforming to ASTM B584-87 copper alloy CDA 844 (81-3-7-9). Hanger spacing shall conform to ANSI B31.9. Hanger selection shall conform to MSS-SP-69.

C. Piping fittings for pipe sizes 1/2 inch through 4 inch shall be Type “L” (above floor) and Type “K” (below floor) copper tube complying with ANSI/ASTM B88. Fittings shall be as described in subparagraph below:

1. Fittings for pipe sizes 4 inch and smaller shall be Type “L” (above floor) and Type “K” (below floor). Piping and fittings shall be joined by a crimping process.

D. Per the Owner’s request, there shall be no exceptions or substitutions for the methods and materials described in this Article.

E. See Specification Section 22 11 17 for optional piping materials.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section “Earth Moving.”

3.2 PIPE AND FITTING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Grooved joints may be used on aboveground grooved-end piping.

D. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

3.3 VALVE APPLICATIONS

A. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball type valves. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."
   1. Manual balancing devices shall be calibrated balance or venturi type. Devices shall be precision machined and calibrated for an accuracy of 3 percent full scale. The induced differential reading shall be greater than one foot water column at the specified flow with the valves in the wide open position. The valves shall have differential read-out ports fitted with check valve and protective cap.
   2. Devices are to have a memory stop to allow complete shut off and return to set position without readjustment.
   3. Construction
      a. For 3/4 inch through 2-1/2 inch pipe size: Bronze or brass body with full port ball valve construction and TFE seat rings.
      b. For 3 inches and larger flange connections: Brass, cast iron or ductile iron body with bronze or stainless steel components.
      c. Conventional port valves and valves 1/2 inch or smaller are not acceptable.
   4. Minimum Ratings
      a. Devices with sweat or press connections: 200 psig at 250 deg F.
      b. Devices with NPT connections: 400 psig at 250 deg F.
      c. Devices with flanged connections: 175 psig at 250 deg F.

B. Shut Off Duty: Use bronze ball valves. For 2 inch and smaller. Use flanged and ball valves with flanged ends for piping 2-1/2 inches and larger.

C. Read-Out Meter Kit

1. Provide a portable readout meter kit by the balancing device manufacturer. The meter shall be permanently mounted in a durable case complete with two 10-foot color coded hoses with shut-off valves at each end that connects to the balance valve so that water does not drain out between readings. The meter shall have a 6-inch diameter face and a 1.75 percent full rated accuracy. The meter for the venture-type devices shall be provided with a removable transparent face indicating flow directly in GPM for each size device furnished. The meter shall have a three valve manifold for over range protection.

D. Balancing devices shall be manufactured by Bell & Gossett, Flow Design, Taco, Nexus, Griswold, Tour and Anderson, Preso Inc., Viega or Armstrong.

E. Drain Duty: Hose-end drain valves.

F. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves.

G. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.

3.4 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."

C. Install shutoff valve, hose-end drain valve, strainer, pressure gauge, and test tee with valve, inside the building at each domestic water service entrance. Pressure gauges are specified in Division 22 Section "Meters and Gauges for Plumbing Piping," and drain valves and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."

D. Install domestic water piping level without pitch and plumb.

E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

3.5 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

C. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.6 HANGER AND SUPPORT INSTALLATION – REFER TO SPECIFICATION SECTION 220529 "HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT"

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve, and extend and connect to the following:
   1. Booster Pumps: Cold-water suction and discharge piping.
   2. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
   4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for 2-1/2 inches and larger.

3.8 TESTING PROCEDURE FOR DOMESTIC HOT WATER RETURN SYSTEMS

A. Check the domestic hot water return pump for specified flow.

B. Domestic hot water return balancing shall be performed in accordance with Division 23 Section “Testing, Adjusting, and Balancing for HVAC.”

3.9 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:
   1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
   2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

3.10 ADJUSTING

A. Perform the following adjustments before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.

3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
    1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
    2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
        a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
        b. Fill and isolate system according to either of the following:
            1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
            2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
        c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
        d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 22 11 16

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide labor, materials, equipment, appliances, services and transportation, and perform operations in connection with construction and installation of the Work. Work shall be as herein specified and as denoted on the accompanying Drawings.

B. This Section includes the following domestic water piping specialties:
1. Reduced pressure principle backflow preventers.
2. Double-check valve assemblies.
3. Pressure type vacuum breakers.
4. Thermostatic mixing valves.
5. Hose bibbs.
6. Wall hydrants.
7. Water hammer arresters.

C. Related Sections include the following:
1. Division 22 Section "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and flow meters in domestic water piping.
2. Division 22 Section "Domestic Water Piping" for water meters.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 ACTION SUBMITTALS

A. Submittals shall consist of:
1. Parts List.
2. Product Data for each type of product indicated.
3. Maintenance Data.
4. Flow and pressure drop characteristics.
5. Operating Instructions.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:
1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

C. Devices shall be included in the list of Approved Backflow Prevention Devices of the USC Foundation for Cross Connection Control and Hydraulic Research and The American National Standard Institute A112.1.2-1942 (1979).

D. All thermostatic mixing valves shall comply with National, State, and Local Codes or Requirements.

E. Thermostatic mixing valves shall meet OBBC, Plumbing Code, Section 4101:2-58-12.

F. All thermostatic mixing valves installed for handicapped usage must comply with the Americans with Disabilities Act and American National Standard Institute A117, Standard for Building Requirements for Handicapped People.

G. Thermostatic mixing valve must be installed in accordance with the manufacturer's specific instructions for type of valve used. Installation must take into consideration location of thermostatic mixing valve to water heater, temperature differences of hot and cold water, pressure drop across valve. Capacity of valve shall be as denoted on the Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Approved Manufacturers
1. Shock Absorbers: Mifab, PPP Products, Wade, Josam, J.R. Smith, Watts, Zurn
2. Thermostatic Mixing Valves: Acorn, Powers, Watts, Bradley, Lawler, Leonard, Symmons, Wilkins, Zurn
3. Adapter Fittings: Fernco
4. Exterior Wall Hydrant: Mifab, Watts, Wade, Josam, J.R. Smith, Zurn, Woodford
5. Clothes Washer Connection: Guy Gray, PPP Products, Acorn
6. Hose Bibb: Chicago, Mifab, Watts, Wade, Josam, J.R. Smith, Zurn, Woodford

2.2 SHOCK ABSORBERS

A. Factory permanently sealed air chamber sized per method established in accordance with Plumbing and Drainage Institute "Standard P.D.I.-WH201."

P.D.I. Rating	Fixture Unit
A	1-11
B	12-32
C	36-60
D	61-113
E	114-154
F	155-330

2.3 THERMOSTATIC MIXING VALVE

A. The combination high-low flow thermostatic mixing valve shall be assembled with the following features:
1. Thermostatic mixing valves which function to meet both high and low demand for tempered water. The thermostatic water mixing valves shall be powered by advanced thermal actuation thermostat to regulate water temperature.
2. Valve to include integral check stops, and outlet dial thermometer and a ball valve shut-off.
3. Valve to include spare thermostatic cartridge.

2.4 EXTERIOR WALL HYDRANT

A. Refer to Plumbing Fixture Schedule on the Drawings for manufacturer/model number.

B. Refer to Architectural Drawings for height in exterior wall.

2.5 CLOTHES WASHER CONNECTION BOXES

A. Refer to Plumbing Fixture Schedule on the Drawings for manufacturer/model number.

2.6 HOSE BIBB

A. Refer to Plumbing Fixture Schedule on the Drawings for manufacturer/model number.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
   3. Do not install bypass piping around backflow preventers.
   4. Install backflow preventers and double-check valve assemblies at 4’-0” to centerline of device.

C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install thermometers and water regulators if specified.

D. Install water hammer arresters in water piping according to PDI-WH 201.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Pressure vacuum breakers.
   2. Reduced-pressure-principle backflow preventers.
   3. Double-check, detector-assembly backflow preventers.
   4. Thermostatic mixing valves.
   5. Photographic-process, thermostatic, water-mixing-valve assemblies.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

B. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

C. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

D. Provide Owner training on all equipment items.

3.5 TESTING AND REPAIR

A. Upon completion of each respective piping system, but prior to insulating, covering, or backfilling, each system shall be thoroughly cleaned and flushed to remove construction dirt and foreign matter.

B. Test Piping as Specified Herein

1. No piping work shall be concealed or covered until it has been inspected and approved by the project inspector, who shall be notified when the Work is ready for inspection. Work shall be completely installed and tested as required by this Contract and Ordinances of the local Municipality and shall be leaktight to the satisfaction of those making the inspection and the A/E.
2. In general, pressure tests shall be applied to piping. In no case shall piping be subject to pressure exceeding its rating. Defective work shall be promptly repaired or replaced and test shall be repeated until the particular system and component parts thereof receive approval of the A/E.
3. Provide temporary equipment for testing, including pump, blower, and gauges. Test piping system before insulation is installed and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve/damper pressure rating.
4. Repair piping systems sections which fail required piping test by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop leak compounds, mastics, or other temporary repair methods.
5. Drain test water from piping systems after testing and repair work has been completed.

C. Damage resulting from tests shall be repaired or damaged materials replaced, to satisfaction of A/E, and at no cost to the Owner.

3.6 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

3.7 STAFF TRAINING

A. Provide minimum 8 hours for school staff training on all equipment.

END OF SECTION 22 11 19

SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following all-bronze and bronze-fitted centrifugal pumps for domestic cold- and hot-water circulation:
   1. Close-coupled, in-line, seal-less centrifugal pumps.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

1.3 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Acceptable Manufacturers: In-Line Circulating Pumps: Grundfos, Bell & Gossett, Taco.

B. Acceptable Manufacturers: Water Pressure Booster Pump: Grundfos, Armstrong, Bell & Gossett.

2.2 IN-LINE CIRCULATING PUMPS

A. Domestic hot water system in-line recirculating pump(s) shall be of the horizontal in-line, all bronze, oil lubricated type, suitable for 125# working pressure. Pump body shall be bronze with brass impeller, heat treated carbon steel shaft, mechanical seal, bronze sleeve-oil lubricated bearings, flexible spring coupler, and ring mounted non-overloading motor. Motor shall be open, drip-proof, sleeve bearing, quiet operating, rubber mounted construction, having built-in thermal overload protection.

B. Each circulating pump shall have sufficient capacity to circulate the scheduled GPM against the scheduled external head (feet) with the horsepower and speed as scheduled or as denoted on the Drawings. Motors shall be of electrical characteristics as scheduled, denoted or as indicated on the electrical plans and Specifications. Pump characteristics shall be such that the head of the pump, under varying conditions, shall not exceed the rated horsepower of the drive motor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

C. Install in-line, seal-less, centrifugal pumps with motor and pump shafts horizontal.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."
   1. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for domestic water piping and Division 22 Section "Domestic Water Piping Specialties" for strainers.
   2. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and gage connectors.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 22 11 23

SECTION 22 13 16 – SANITARY, WASTE, AND VENT PIPING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:
   1. Pipe, tube, and fittings.
   2. Floor drains.
   3. Cleanouts.
   4. Adapter fittings.

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water.
   2. Sanitary Sewer, Force-Main Piping: 150 psig.

1.3 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, couplings, floor drains, and trench drains.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

B. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. All cast iron soil piping and fittings shall comply with ASTM A 888 (or A 74) and be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Acceptable Manufacturers
   1. Cleanouts and Floor Drains: Zurn, Wade, Josam Company, J. R. Smith, Mifab, Watts
   2. Adapter Fittings: Fernco
   3. Trench Drains: Zurn, Aco, Polydrain, Josam/MEA)
   4. Pipe Tube and Fittings: Tyler, Charlotte, AB&I

2.2 CLEANOUTS

A. Floor: Cast iron, inside caulking, with adjustable nickel-bronze round tops; ZN1400-BZ. Provide Zurn “-CF” carpet cleanout flange in carpeted areas. Review Finish Schedule for locations.

B. Wall: Concealed screw plug with countersunk wrench hole and stainless steel screwed flush cover and frame. Zurn ZS1468.

C. Exterior: Round cast iron frame with anchor flanges and heavy duty cover. Josam 58680 or approved equal. Install cleanout in 2’ x 2’ concrete pad, level with grade.

D. Review Finish Schedule for locations.

2.3 ADAPTER FITTINGS

A. Adaptor fittings shall be used where changing from one type of material to another such as: "DWV" to cast iron soil pipe shall be with an approved brass adapter ferrule and caulk "DWV" into cast iron hub. Leaded joint against "DWV" copper is not permitted. Cast iron soil pipe to vitrified tile connection shall be made using ABS "Fernco Donut" gasket.

2.4 FLOOR DRAINS

A. Floor Drain (all finished areas on or above grade conditions). Floor Drains installed in floor slabs above grade shall include anchor flange and weepage hole option.

B. Floor Drain "FD-1": Ground floor and above ground floor conditions. Cast iron body and flashing color, nickel bronze square adjustable strainer head with secured square hole grate; Zurn ZN415-6SZ.

C. Floor Drain “FD-2” (Mechanical Equipment Rooms on or above grade conditions): Cast iron body and flashing collar with square cast iron grate and slotted sediment bucket, provided with deep seal ‘P’ trap; Zurn Z610-DG.

D. Floor Drain “FD-3”: Provide a 12 inch by 12 inch by 8 inch floor drain 3” outlet sink with a square nickel bronze top with deep seal ‘P’ trap, 1/2 grate **where not in walkpaths, full grate in walk paths, confirm quantities prior to order**, aluminum sediment bucket. Zurn ZN1901-P-23-2-KC.

E. Floor Drain “FD-4”: Provide a 12 inch by 12 inch by 8 inch floor drain 4” outlet sink with a square nickel bronze top with deep seal ‘P’ trap, 1/2 grate **where not in walkpaths, full grate in walk paths, confirm quantities prior to order**, aluminum sediment bucket. Zurn ZN1901-P-23-2-KC.

F. Floor Drain “FD-4SS”: Provide a 12 inch by 12 inch by 8 inch stainless steel floor drain sink with a square top with deep seal ‘P’ trap. Zurn ZS1810-8S. **Provide with ½ grate.**

G. Floor Drain “FD-7”: Cast iron body with deep seal ‘P’ trap and floor cleanout, flashing collar, nickel bronze dome strainer head; Zurn ZN415-6G.

H. Floor Drain “FD-8”: Provide a 6 inch by 6 inch non-adjustable, shallow pour drain for use only in elevated flexicore deck with shallow thin set topping slab. Modify the strainer with a 2” center hole to accommodate indirect waste from mechanical equipment; Zurn ZPD1-ZPTSP.

I. Size: As described on the Drawings.

J. Tops: Adjustable nickel-bronze.

K. Strainers: 6 inch square. All strainers shall be adjustable nonclog style. (Exception: FD-4)

L. Bodies: Cast iron, double drainage type.

M. Flashing Rings: Nonpuncture clamping rings are required wherever membrane waterproofing occurs.

N. Traps: All traps shall be cast iron, deep seal (4 inches minimum seal).

O. Cleanouts: As shown and as required by Code.

P. Trap seal primer valve shall conform to ASSE 1018, 1072 or ASSE 1044 equal to SureSeal or Green Drain.

Q. Trap Primers: Prime-Time Electronic Trap Priming Manifold Kit as manufactured by PPP Products shall be installed in the vertical cold water piping serving the hose bibb(s) in the mechanical mezzanines at +48 inches AFF. Trap primer water service shall then be extended and connected to the floor drain traps as indicated on the Drawings. Prime-Time Electronic Trap Priming Manifold Kit as manufactured by PPP Products shall be provided in the cold water supply piping to the science rooms for trap primer service to the emergency shower floor drain traps. Refer to Drawings for location of trap primer valve assembly.

2.5 SANITARY, WASTE, AND VENT PIPING

A. Aboveground Piping:
1. Pipe size 1-1/2 inches through 15 inches: Hubless cast iron soil pipe, service weight; hubless cast iron soil pipe fittings, hubless joints, ASTM A-74; CISPI 301. All cast iron soil pipe and fittings shall bear the collective mark of the cast iron soil pipe institute. Copper D.W.V., ASTM B306 piping and fittings is also acceptable.
2. Hubless cast iron soil pipe shall be joined using “Heavy Weight” couplings torqued to 80 inch/lbs meeting the requirements of ASTM by Clamp-All, Mission or Husky. Couplings shall be constructed of type 304 stainless steel with 305 Stainless Steel worm drive screws; 4 bands 4 inch and below, 6 bands 5 inch and above. The gasket material shall be neoprene and conform to ASTM C-564.
3. Heavy Duty couplings as described above may be provided by the pipe manufacturer for fitting locations only. All straight runs of pipe must be joined.

B. Underground Piping:
1. Pipe size 2 inches through 15 inches: Cast iron hub and spigot soil pipe service weight; Cast iron hub and spigot soil pip fittings, ASTM A-74; CISPI 301; compression gasket joints, ASTM C564-70, or lead and oakum joints are acceptable. All cast iron soil pipe and fittings shall bear the collective mark of the cast iron soil pipe institute.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

3.3 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to 4 inches. Use 4 inches for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains as noted on the Drawings. Set grates of drains 1/2 inch below finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
2. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

3. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install trench drains at low points of surface areas to be drained. Set grates at elevation noted on Drawings.

F. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

G. Assemble trench drain and catch basin system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

H. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

I. Install deep-seal traps on floor drains and other waste outlets.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install traps on plumbing specialty drain outlets.

M. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

N. All sanitary vent piping, including acid vent piping, which terminates to any exterior point, shall extend to a point 2’-0” above any outdoor air intake which are located within 10’-0” of the intake opening.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.5 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

E. Install mechanical sleeve (in basement conditions). Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Building Sanitary Drain: 1/4 inch per foot downward in direction of flow for piping 2 inches and smaller; 1/8 inch per foot downward in direction of flow for piping 3 inches and larger.
   2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.6 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.7 HANGER AND SUPPORT INSTALLATION

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Install individual, straight, horizontal piping runs according to the following:
      a. MSS Type 1, adjustable, steel clevis hangers.
   3. Support stacks at each floor with two-piece risers clamps.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.10 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 13 16

SECTION 22 14 13 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following storm drainage piping inside the building:
   1. Pipe, tube, couplings, and fittings.
   2. Cleanouts.
   3. Adaptor fittings.
   4. Roof drains/overflow drains.
   5. Miscellaneous storm drainage piping specialties.
   6. Flashing materials.

1.2 ACTION SUBMITTALS

A. Product Data: For pipes, tubes, fittings, couplings, roof drains/overflow drains, trench drains, cleanouts, and storm drainage piping specialties.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Field static head test reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Aboveground Piping:
   1. Pipe size 1-1/2 inches through 15 inches: Hubless cast iron soil pipe, service weight; hubless cast iron soil pipe fittings, hubless joints, ASTM A 888; CISPI 301. All cast iron soil pipe and fittings shall bear the collective mark of the cast iron soil pipe institute.
   2. Hubless cast iron soil pipe shall be joined using “Heavy Weight” couplings torqued to manufacturer’s recommended torque using a calibrated torque wrench meeting the requirements of ASTM C 1540 by Clamp-All, Mission, Husky or approved equal. Couplings shall be constructed of type 304 stainless steel with 305 Stainless Steel worm drive screws; 4 bands 4 inch and below, 6 bands 5 inch and above. The gasket material shall be neoprene and conform to ASTM C 564.
   3. Couplings from pipe manufacturer are not acceptable.

B. Underground Piping:
   1. Pipe size 2 inches through 15 inches: Cast iron hub and spigot soil pipe service weight; Cast iron hub and spigot soil pipe fittings, ASTM A 74; CISPI 301; compression gasket joints, ASTM C 564, or lead and oakum joints are acceptable. All cast iron soil pipe and fittings shall bear the collective mark of the cast iron soil pipe institute.

2.2 CLEANOUTS

A. Floor: Cast iron, inside caulking, with adjustable nickel-bronze round tops; Josam No. 55000-1. Provide Josam No. 55000-1-14 carpet marker in carpeted areas. Review Finish Schedule for locations.

B. Wall: Concealed screw plug with countersunk wrench hole and stainless steel screwed flush cover and frame; Josam 58600-PLG. Review Finish Schedule for locations.

C. Exterior: Round cast iron frame with anchor flanges and heavy duty cover. Josam 58680 or approved equal. Install cleanout in 2’ x 2’ concrete pad, level with grade.

2.3 ADAPTER FITTINGS

A. Adaptor fittings shall be used where changing from one type of material to another such as: "DWV" to cast iron soil pipe shall be with an approved brass adapter ferrule and caulk "DWV" into cast iron hub. Leaded joint against "DWV" copper is not permitted. Cast iron soil pipe to vitrified tile connection shall be made using ABS "Fernco Donut" gasket.

2.4 ROOF DRAINS/OVERFLOW DRAINS

A. Roof Drains: Comply with ASME A112.3.1.
   1. Basis-of-Design: Zurn ZC100F; sizes as indicated.
      a. Subject to compliance with requirements, provide either named product or comparable product by one of the following:
         1) Mifab
         2) Josam, Michigan City, Indiana
         3) J. R. Smith, Montgomery, Alabama
         4) Zurn, Jamestown, New York
         5) Wade
         6) Watts Drainage Products, North Andover, Maryland
   2. Construction: Cast iron or aluminum body with flange, flashing ring with integral gravel stop, adjustable extension ring, and noncorrosive clamping units hinged to body, cast iron, aluminum, or stainless steel mushroom type dome strainer, and deck clamp.
      a. Outlet and body dimensions shall be coordinated with plumbing work.
   3. Overflow Drain: Drain shall allow for no more than 2 inches of ponded water before it begins to relieve primary drain. Overflow drain shall use an internal water dam or external water dam/gravel stop clamping collar. Provide a companion overflow drain, connected to the building storm water system for every roof drain shown in the Architectural Roof Plan. Zurn ZC100F-89.

2.5 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152, 12 oz./sq. ft. thickness.

B. Zinc-Coated Steel Sheet: ASTM A 653, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Test Procedure: Test storm drainage piping[**, except outside leaders,**] on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   5. Prepare reports for tests and required corrective action.

C. Install cast iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

3.2 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheet.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.3 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 14 13

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:
   1. Flushometers.
   2. Toilet seats.
   3. Fixture supports.
   4. Water closets.
   5. Urinals.
   6. Lavatories.
   7. Commercial sinks.
   8. Wash fountains.
   9. Sinks.
   10. Floor service sinks.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

1.3 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"[**; Public Law 90-480, "Architectural Barriers Act" ; and Public Law 101-336, "Americans with Disabilities Act" ;**] for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   1. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
   2. Stainless-Steel Residential Sinks: ASME A112.19.3.
   3. Vitreous-China Fixtures: ASME A112.19.2M.

H. ARI Standard: Comply with ARI "Directory of Certified Drinking Water Coolers" for style classifications.

I. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI "Directory of Certified Drinking Water Coolers" for type and style classifications.

J. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

K. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
   1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
   2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
   3. Faucets: ASME A112.18.1.
   4. Hose-Connection Vacuum Breakers: ASSE 1011.
   5. Hose-Coupling Threads: ASME B1.20.7.
   6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
   7. NSF Potable-Water Materials: NSF 61.
   8. Pipe Threads: ASME B1.20.1.
   9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
   10. Supply Fittings: ASME A112.18.1.
   11. Brass Waste Fittings: ASME A112.18.2.

L. Comply with the following applicable standards and other requirements specified for shower faucets:
   1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
   2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
   3. Faucets: ASME A112.18.1.
   4. Hand-Held Showers: ASSE 1014.
   5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
   6. Hose-Coupling Threads: ASME B1.20.7.
   7. Manual-Control Antiscald Faucets: ASTM F 444.
   8. Pipe Threads: ASME B1.20.1.
   9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
   10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
   11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

M. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
   1. Atmospheric Vacuum Breakers: ASSE 1001.
   2. Brass and Copper Supplies: ASME A112.18.1.
   3. Dishwasher Air-Gap Fittings: ASSE 1021.
   4. Manual-Operation Flushometers: ASSE 1037.
   5. Brass Waste Fittings: ASME A112.18.2.
   6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

N. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. Disposers: ASSE 1008 and UL 430.
   2. Dishwasher Air-Gap Fittings: ASSE 1021.
   3. Flexible Water Connectors: ASME A112.18.6.
   4. Floor Drains: ASME A112.6.3.

5. Hose-Coupling Threads: ASME B1.20.7.
6. Off-Floor Fixture Supports: ASME A112.6.1M.
7. Pipe Threads: ASME B1.20.1.
8. Plastic Toilet Seats: ANSI Z124.5.
9. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 WARRANTY

A. Warranty Period for Commercial Applications: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lavatories
1. American Standard, Kohler, Crane, Eljer, Zurn, Sloan, Toto
2. Trim: Zurn Aquaspec,

B. Water Closets and Urinals
1. Water Closet and Urinal : American Standard, Kohler, Crane, Eljer, Zurn, Sloan, Toto
2. Flush Valve: Sloan
3. Seats: Beneke, Olsonite, Bemis, Church, Centoco, Zurn

C. Sinks
1. Elkay, Just
2. Trim: Zurn Aquaspec,

D. Showers
1. Acorn, Willoughby, Powers, Bradley, Symmons, Leonard, Speakman, Zurn

E. Shower Units
1. Freedom Showers, Aquarius, Aquabath, Comfort Designs

F. Mop Basin
1. Sink: Fiat, Swan, Acorn, Mustee
2. Trim: Zurn Aquaspec, T & S Brass, Chicago, Cambridge Brass, Speakman, Moen Commercial

G. Wall Service Sink
1. Elkay, Just

H. Lavatory, Sink and Water Fountain/Cooler Connections
1. Mcguire, Chicago, American Standard, Kohler, T&S Brass, Crane, Zurn, Dearborn Brass

I. Wash Fountains
1. Bradley, Acorn, Willoughby

2.2 GENERAL REQUIREMENTS

A. Exposed connections and trim to fixtures shall be chromium plated. Trim shall be chrome-plated brass, unless otherwise specified. Each fixture shall have chrome plated stops in the supplies and escutcheons at wall.

B. Unless otherwise specified, lavatory and sink connections to include Quarter Turn Ball Type supply stops with removable handles, with 1/2 inch female inlet, 12 inches long, 3/8 inch OD flexible riser and wall flange. Finish to be polished chromium plate. Supply Stops shall be McGuire LFBV216X series or equal by Zurn or EBF. "P" trap shall be 1-1/2 inches chrome-plate cast brass #8-394 with cleanout made by Brass Craft Manufacturing Co., Zurn, or McGuire.

C. Flow restriction devices shall be used on plumbing fixtures (other than units used for safety reasons) to meet the requirements as set forth in the State and Local Building Codes for new building construction.

D. All handicap fixtures and trim shall meet ADA Requirements. Exposed supplies and trap on all fixtures with exposed supplies and drain shall be wrapped with insulation equal to trap wrap by Brocar Products, Inc, or Trubro.

E. All fixture and trim screw attachments shall be vandal resistant.

F. Provide offset grid strainer and tailpiece for ADA accessible lavatories and sinks.

G. Provide approved white sealant at all fixtures to wall and sinks/lavs to casework tops.

H. Sinks are to be furnished and installed under this Contract. This Contractor to provide trim, supplies, stops, escutcheons, plates, traps, and the like for complete plumbing installation and to furnish the casework manufacturer templates for cutting sink holes for all plumbing fixtures shown on the Plumbing and Architectural Drawings. See Equipment Schedules and Drawings for types and locations.

I. All faucets shall be heavy duty and be provided with ceramic disc valving.

J. Refer to Plumbing Fixture Schedule on the Drawings for additional requirements.

K. Stainless steel casework sinks designated to be handicapped accessible shall be provided with sink drain openings offset to the center rear.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install counter-mounting fixtures in and attached to casework.

F. Install fixtures level and plumb according to roughing-in drawings.

G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

I. Install tubular waste piping on drain outlet of each fixture designated to be indirectly connected to drainage system.

J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

K. Install toilet seats on water closets.

L. Install traps on fixture outlets.
1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

M. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.

N. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."

O. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

P. Supplies and waste shall run in wall wherever practicable.

Q. Pipes shall be jointed to plumbing fixtures with screwed tailpiece couplings and unions so that fixtures can be easily removed and reset.

R. An escutcheon plate to match the pipe shall be used around waste and supply piping wherever same passes through floors, walls, or ceilings.

S. Provide adjustable lavatory, urinal, and water closet carriers to support each independently of wall. Carriers shall be complete with feet and vertical or horizontal style waste fittings to comply with waste and vent arrangement indicated on the accompanying Drawings and as required by construction. Supporting feet must be located within wall or in pipe space without damage to wall face. Manufacturer shall provide suitable template frames for mounting on carriers before tiling of wall for adjustment.

T. Furnish vacuum breakers on fixtures or equipment having under-rim supply or hose connection, as furnished or installed under this Contract.

U. Provide caulk sealant on all plumbing fixtures.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping for all fixtures shown on the Plumbing and Architectural Drawings. Use size fittings required to match fixtures.

C. Coordinate grounding of equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Coordinate wiring connections according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

B. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

C. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

D. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

END OF SECTION 22 40 00

SECTION 22 45 00 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following emergency plumbing fixtures:
   1. Emergency showers.
   2. Eye/face wash equipment.
   3. Combination units.
   4. Water-tempering equipment.

B. Related Sections include the following:
   1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
   2. Division 22 Section "Sanitary Waste Piping Specialties" for floor drains.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

B. Field quality-control test reports.

1.4 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For emergency plumbing fixtures to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

B. Regulatory Requirements: Comply with "Americans with Disabilities Act."

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. Temperature mixing valve shall meet ASSE 1071.

PART 2 - PRODUCTS

2.1 EMERGENCY SHOWERS AND EYE WASHES – Refer to Plumbing Fixture Schedule on PLUMBING Drawings for Product Design Basis

A. Emergency Showers and Eye Washes
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Bradley Corporation.
      b. Encon Safety Products.
      c. Guardian Equipment Co.
      d. Haws Corporation.

e. Speakman Company.
f. WaterSaver Faucet Co.
g. Acorn Safety

2. Description: Plumbed, single-shower-head horizontal, wall-mounted or vertical, ceiling-mounted emergency shower.
   a. Capacity: Deliver potable water at rate not less than 20 gpm for at least 15 minutes, minimum.
   b. Supply Piping: 1-1/4 copper with stay-open control valve.
   c. Control-Valve Actuator: Pull rod.
   d. Shower Head: 8-inch minimum diameter, plastic.

2.2 EYEWASH EQUIPMENT – REFER TO PLUMBING FIXTURE SCHEDULE ON PLUMBING DRAWINGS

A. Eyewash Equipment:
1. Description: Plumbed, accessible, wall-mounted eye and face wash equipment with receptor and wall bracket.
   a. Capacity: Deliver potable water at rate not less than 3.0 gpm for at least 15 minutes.
   b. Supply Piping: 3/4 inch copper (concealed) with stay-open control valve.
   c. Control-Valve Actuator: Paddle.
   d. Receptor: Stainless-steel bowl.
   e. Drain Piping: NPS 1-1/4 minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2.

2.3 COMBINATION SHOWER/EYE WASH UNITS – REFER TO PLUMBING FIXTURE SCHEDULE ON PLUMBING DRAWINGS

A. Combination Shower/Eyewash Units
1. Description: Plumbed, freestanding, with emergency shower and eye/face wash equipment.
2. Description: Plumbed, accessible, recessed eyewash bowl, push paddle, and pull rod actuator.
   a. Unit Supply: 1-1/4 inch minimum
   b. Unit Drain: Outlet at side near bottom. Extend over to floor drain.
   c. Shower Capacity: Deliver potable water at rate not less than 20 gpm for at least 15 minutes.
      1) Control-Valve Actuator: Pull rod.
      2) Shower Head: 8 inch minimum diameter, plastic.
   d. Eyewash Equipment: With capacity to deliver potable water at rate not less than 0.4 gpm for at least 15 minutes.
      1) Control-Valve Actuator: Paddle.
      2) Receptor: Plastic.

2.4 EMERGENCY EQUIPMENT THERMOSTATIC MIXING VALVE – REFER TO PLUMBING EQUIPMENT SCHEDULE ON PLUMBING DRAWINGS

A. Emergency Equipment Thermostatic Mixing Valve:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bradley Corporation.
   b. Lawler Manufacturing Co., Inc.
   c. Leonard Valve Company.
   d. Powers, a Watts Industries Co.
   e. Speakman Company.
2. Description: Factory-fabricated, hot and cold water-tempering equipment with thermostatic mixing valve.
   a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue

cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 22 Section "Common Work Results for Plumbing."

F. Install thermometers in outlet piping connections to water-tempering equipment. Thermometers are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."

G. Install trap and waste to wall on drain outlet of fixture receptors that are indicated to be directly connected to drainage system.

H. Install indirect waste piping to wall on drain outlet of fixture receptors that are indicated to be indirectly connected to drainage system. Drainage piping is specified in Division 22 Section "Sanitary Waste and Vent Piping."

I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

J. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment. Identification materials are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment.

C. Connect hot and cold water supply piping to hot and cold water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.

D. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary drainage and vent piping.

E. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary drainage piping.

3.4 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.

B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

C. Report test results in writing.

3.5 ADJUSTING

A. Adjust equipment temperature settings.

END OF SECTION 22 45 00

SECTION 22 47 00 - DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following drinking fountains and water coolers and related components:
   1. Drinking fountains.
   2. Drinking water coolers.
   3. Fixture supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

1.3 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in "Americans with Disabilities Act."

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS – REFER TO PLUMBING FIXTURE SCHEDULE ON PLUMBING DRAWINGS FOR PRODUCT DESIGN BASIS

A. Drinking Fountains
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Acorn
      b. Elkay Manufacturing Co.

c. Halsey Taylor.
d. Haws Corporation.
e. Oasis Corporation.
f. Murdock

2.2 DRINKING WATER COOLERS – REFER TO PLUMBING FIXTURE SCHEDULE ON PLUMBING DRAWINGS FOR PRODUCT DESIGN BASIS

A. Drinking Water Coolers
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn
b. Elkay Manufacturing Co.
c. Halsey Taylor.
d. Haws Corporation.
e. Oasis Corporation.
f. Murdock

2.3 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
1. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Use carrier supports for wall-mounting fixtures, unless otherwise indicated.

B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

A. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

C. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

D. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

E. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant, as approved by A/E (white). Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.5 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
1. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.7 CLEANING

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 22 47 00

SECTION 22 66 13 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Mechanical sleeve seals.
7. Concrete bases.

B. Provide new piping for the natural gas service which shall be installed in strict accordance with the latest edition of the Pressure Piping Code, NFPA Code #54, and in confirmation with the local gas utility company requirements, as approved by the Architect/Engineer.

C. Contractor shall make his own arrangements with local gas utility company for connection on house side of gas meter or regulator.

D. This Contractor is responsible for all work on the gas system which occurs downstream of the gas meter. This includes all valves, gas pressure regulators inside or outside of the building, gas pressure regulator vents for a complete and operational system. The Contractor shall review the Site Utility Drawings, including the “SP” series, and provide all additional work required to complete work entirely to the point just downstream of gas meter.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.3 PERFORMANCE REQUIREMENTS

A. Natural-Gas System Pressure within Buildings: 0.5 psig but not more than 2 psig.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following:
1. Piping specialties.
2. Piping materials and associated components a specified.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.

1.5 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Owner's written permission.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Gas piping for pipe sizes 2 inches and smaller may be Schedule 40 steel pipe with threaded malleable iron fittings in compliance with NFPA 54 (1988) Section 2.6.8. Gas piping and fittings for pipe sizes 2-1/2 inches and larger shall be welded Schedule 40 black steel. Piping smaller than 1/2 inch NPS will not be allowed.

B. Fittings shall be standard weight welding fittings, Nibco, Tubeturns, Allied, or approved equal.

C. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1. (Pipe sizes 2 inches and smaller.)
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. OmegaFlex, Inc.
2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
3. Coating: PE with flame retardant.
   a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      1) Flame-Spread Index: 25 or less.
      2) Smoke-Developed Index: 50 or less.

4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
5. Striker Plates: Steel, designed to protect tubing from penetrations.
6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.

D. Gas tubing for exterior underground installation only shall be ASTM D 2513 high density polyethylene tubing, IPS pipe sizing, with SDR 11 for 4" size and SDR 13.5 for 6" size. Piping shall meet PE3408 or PE4710. Underground site gas piping shall be installed as indicated on the drawings, installed per International Fuel Gas Code requirements. Piping shall be installed below frost depth, with warning/excavation tape installed in bedding material above piping. Piping installation shall include tracer wire installation along entire pipe length. Tracer wire shall be 18 AWG gauge wire with insulation compatible for direct bury installations. Tracer wiring terminal connections shall be provided at riser locations to above grade. Material transition fittings, including anodeless risers shall be provided at all transitions from above grade steel piping to below grade polyethylene piping. Outdoor plastic piping shall be tested to 150% of service pressure, using compressed air or inert gas. Pressure test duration shall meet or exceed ½ hour per each 500 cubic feet of pipe volume.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for 2 inches and smaller; flanged ends for 2-1/2 inches and larger.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, 2 inches and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125 psig.
   2. Threaded Ends: Comply with ASME B1.20.1.
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
   6. Service Mark: Valves 1-1/4 inches to 2 inches shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, 2-1/2 inches and Larger: Comply with ASME B16.38.
   1. CWP Rating: 125 psig.
   2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
   3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BrassCraft Manufacturing Company; a Masco company.
      b. Conbraco Industries, Inc.; Apollo Div.
      c. McDonald, A. Y. Mfg. Co.
   2. Body: Bronze, complying with ASTM B 584.
   3. Ball: Chrome-plated bronze.
   4. Stem: Bronze; blowout proof.
   5. Seats: Reinforced TFE; blowout proof.
   6. Packing: Threaded-body packnut design with adjustable-stem packing.
   7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   8. CWP Rating: 600 psig.
   9. Listing: Valves 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Lee Brass Company.
      b. McDonald, A. Y. Mfg. Co.
   2. Body: Bronze, complying with ASTM B 584.
   3. Plug: Bronze.
   4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
   5. Operator: Square head or lug type with tamperproof feature where indicated.
   6. Pressure Class: 125 psig.
   7. Listing: Valves 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. McDonald, A. Y. Mfg. Co.
    b. Mueller Co.; Gas Products Div.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. McDonald, A. Y. Mfg. Co.
    b. Mueller Co.; Gas Products Div.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

A. General Requirements:
1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators 2 inches and smaller; flanged for regulators 2-1/2 inches and larger.
5. Each regulator shall be vented independently to the outside atmosphere with an approved vent cap. Verify sizes and venting requirements with the gas company.
6. Gas piping installed in a ceiling air plenum area shall not contain any valves or unions.

B. Service Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Equimeter.
    b. Rockwell.
    c. Dresser.
    d. Itron.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.

9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

C. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Equimeter.
   b. Rockwell.
   c. Dresser.
   d. Itron.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 2 psig or 5 psig.

D. Appliance Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Equimeter.
   b. Rockwell.
   c. Dresser.
   d. Itron.
   e. Maxitrol.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 0.5 psig.

2.6 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.7 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

2.8 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Steel Piping with Protective Coating:
   1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
   2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
   3. Replace pipe having damaged PE coating with new pipe.

C. Install fittings for changes in direction and branch connections.

D. Aboveground, Exterior-Wall and Slab Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

E. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

F. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

G. Install pressure gauge upstream and downstream from each service regulator. Pressure gauges are specified in Division 23 Section "Meters and Gauges for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install escutcheons at penetrations of interior walls, ceilings, and floors.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

M. Verify final equipment locations for roughing-in.

N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

R. Concealed Gas Supply Piping Locations: A Schedule 40 plastic coated or mill wrapped welded gas casing vent that is a minimum of two times the pipe diameter larger than the supply pipe shall be installed on all concealed gas supply piping, i.e., below floors, in walls, and vented full size directly to atmosphere and terminated with a 90 degree gooseneck fitting and bug screen. The vent pipe shall be sealed around the supply pipe at each point where pipe enters and exits the concealed space. All fittings shall be coated and a test of 50 psi for 10 minutes be made before covering. Installation shall be in accordance with NFPA 54 and the International Fuel Gas Code.

S. All gas valves installed shall be accessible below ceilings outside of concealed areas and no higher than 54 inches AFF.

T. All gas piping and equipment regulator vent piping from a point downstream of the gas meter to the final connection to equipment shall be painted yellow like Porter Paints No. D6209-4.
   1. Prohibited Locations:
      a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
      b. Do not install natural-gas piping in solid walls or partitions.

U. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

V. Connect branch piping from top or side of horizontal piping.

W. Install unions in pipes 2 inches and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

X. Do not use natural-gas piping as grounding electrode.

Y. Install strainer on inlet of each line-pressure regulator.

Z. Install pressure gauge upstream and downstream from each line regulator. Pressure gauges are specified in Division 23 Section "Meters and Gauges for HVAC Piping."

AA. Horizontal runs shall grade down to riser at a pitch of 1/4 inch in 15 feet.

BB. At each point where gas piping connects to equipment and at the bottom of each riser, furnish and install suitable drip leg or moisture pocket comprising drip pocket not les than 12 inches long, unless otherwise indicated, with reducer and 125 lb. black malleable cap for blowing out drip pockets.

CC. Piping systems for natural gas shall be electrically continuous and properly bonded to an approved grounding electrode in accordance with the National Electrical Code, NFPA No. 70.

DD. Gas lines shall be purged to the outside atmosphere before being put into service. Purging must be witnessed by the Architect or an authorized person to witness purging of the lines.

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.6 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.
   3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
   4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
   5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:
   1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
   2. Bevel plain ends of steel pipe.
   3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.7 HANGER AND SUPPORT INSTALLATION

A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. 1 inch and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   2. 1-1/4 inches: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   3. 1-1/2 and 2 inches: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   4. 2-1/2 to 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
   5. 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

B. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
   1. 3/4 inch and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.8 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base.
   1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified.

C. Perform tests and inspections.

D. Tests and Inspections:
   1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.

E. Natural-gas piping will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.11 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes 2 inches and smaller at service meter shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.

B. Valves for pipe sizes 2-1/2 inches and larger at service meter shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.
   2. Bronze plug valve.
   3. Cast-iron, nonlubricated plug valve.

C. Valves in branch piping for single appliance shall be one of the following:
   1. One-piece, bronze ball valve with bronze trim.
   2. Two-piece, full-port, bronze ball valves with bronze trim.
   3. Bronze plug valve.

END OF SECTION 22 66 13

23

DIVISION

SECTION 23 01 30 - HVAC AIR DUCT CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes cleaning of the following existing duct systems:
   1. Supply air system.
   2. Return air system.
   3. Outside air system.
   4. Exhaust air system.
   5. Relief air system.

1.2 DEFINITIONS

A. ASCS: Air system cleaning specialist.

B. NADCA: National Air Duct Cleaners Association.

C. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.

B. Qualification Data: For ASCS.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. ASCS Qualifications: A certified member of NADCA or a member of a nationally recognized nonprofit industry organization dedicated to the cleaning of HVAC systems.
   1. Certification: Employ a staff of ASCS certified by a nationally recognized certification program.
   2. Supervisor Qualifications: Certified by a nationally recognized program and organization.
   3. Experience: Submit records of experience in the field of HVAC systems cleaning.
   4. Equipment, Materials, and Labor: Have equipment, materials, and labor required to perform specified services.

B. Comply with current published standards of NADCA.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to Metal Ducts, Nonmetal Ducts, Air Duct Accessories, and other applicable sections for materials requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine systems to determine appropriate methods, tools, and equipment required for performance of work. The cleaning of ductwork may not be required if care is taken during construction to keep ductwork clean of any and all dirt and debris. The A/E will need to approve all ductwork not cleaned.

B. Prepare written report listing conditions detrimental to performance of work.

C. Proceed with work only after unsatisfactory conditions have been corrected.

3.2 CLEANING

A. Engage a qualified ASCS to clean the following systems (**for Existing AHU-1, Existing EF-1, Existing EF-3 and Existing Relief hood over room 133**):
   1. Supply air system.
   2. Return air system.
   3. Outside air system.
   4. Exhaust air system.
   5. Relief air system.

B. Perform cleaning before air balancing or mark position of dampers and air-directional mechanical devices before cleaning.

C. Use duct-mounted access doors, as required, for physical and mechanical entry and for inspection.
   1. Install additional duct-mounting access doors to comply with duct cleaning standards. Comply with requirements in Division 23 Section "Air Duct Accessories" for additional duct-mounting access doors.
   2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection. Replace damaged and deteriorated flexible ducts. Comply with requirements in Division 23 Section "Air Duct Accessories" for flexible ducts.
   3. Disconnect and reconnect flexible connectors as needed for cleaning and inspection. Replace damaged and deteriorated flexible connectors. Comply with requirements in Division 23 Section "Air Duct Accessories" for flexible connectors.
   4. Reseal rigid-fiberglass-duct systems according to NAIMA recommended practices.

5. Replace damaged fusible links on fire and smoke dampers. Replacement fusible links shall be same rating as those being replaced. Comply with requirements in Division 23 Section "Air Duct Accessories" for fusible links.
6. Remove and reinstall ceiling components to gain access for duct cleaning. Clean ceiling components after they have been removed and replaced.

D. Mark position of dampers and air-directional mechanical devices before cleaning. Restore to their marked position on completion.

E. Particulate Collection and Odor Control:
1. Where venting vacuuming system inside building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or greater) particles.
2. When venting vacuuming system outside building, use filtration to contain debris removed from the HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.

F. Clean the following metal-duct system components by removing visible surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling-unit internal surfaces and components including mixing box, coil sections, heat recovery sections, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators, except in ceiling plenums and mechanical room.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components.
8. Relief air ductwork, dampers, actuators, and components.
9. Outside air ducts, dampers, actuators, and any component located in the outside air stream.

G. Mechanical Cleaning Methodology:
1. Clean metal-duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of ducts so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts or duct liner.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment, and do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide operative drainage system for washdown procedures.
7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present; use according to manufacturer's written instructions after removal of surface deposits and debris.

H. Cleanliness Verification:
   1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
   2. Visually inspect metal-duct systems for contaminants.
   3. Where contaminants are discovered, re-clean and re-inspect duct systems.

3.3 CONNECTIONS

A. Reconnect ducts to fans and air-handling units with existing flexible connectors after cleaning ducts and flexible connectors. Replace existing damaged and deteriorated flexible connectors.

B. For fans developing static pressures of 5-inch wg and higher, cover replacement flexible connectors with loaded vinyl sheet held in place with metal straps.

C. Reconnect terminal units to supply ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 24-inch lengths of new flexible duct.

D. Reconnect diffusers low-pressure ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 8 feet lengths of flexible duct clamped or strapped in place.

E. Reconnect existing and new flexible ducts to metal ducts with draw bands. All new flexible ducts and draw bands in plenums shall be rated for plenum use.

3.4 FIELD QUALITY CONTROL

A. Gravimetric Analysis: Sections of metal-duct system, chosen randomly by Owner and/or Architect, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.
   1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
   2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal-duct system shall be re-cleaned and re-verified.

B. Verification of Coil Cleaning: Cleaning shall restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

C. Report results of tests in writing.

END OF SECTION 23 01 30

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Mechanical sleeve seals.
   5. Sleeves.
   6. Escutcheons.
   7. Grout.
   8. HVAC demolition.
   9. Equipment installation requirements common to equipment sections.
   10. Painting and finishing.
   11. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. CPVC: Chlorinated polyvinyl chloride plastic.
   2. PE: Polyethylene plastic.
   3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene monomer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Mechanical sleeve seals.
   3. Escutcheons.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements. Mechanical Contractor is to assume all financial responsibility associated with higher electrical characteristics.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. Sheet metal accessories shall include air distribution outlets, air filters, sound attenuators and ductwork accessories.

D. Store all insulation, ductwork, and sheet metal accessories indoors, or in a storage trailer. Do not store outdoors. Any insulation, ductwork, or accessories stored outdoors will be rejected, and shall be removed from the project site by the Contractor.

E. Do not allow insulation, ductwork, or sheet metal accessories to be exposed to moisture, to avoid introduction of mold spores into the building.

F. Do not run air systems prior to ductwork being insulated, to prevent condensation from occurring on the ductwork.

G. Equipment covered under this article include the following:
   1. Air handling units
   2. Boilers
   3. VAV terminals
   4. Coils
   5. Unit heaters
   6. Cabinet unit heaters
   7. Exhaust fans
   8. Pumps

H. Air handling units shall be shipped fully crated or shrink-wrapped from the factory for protection of the equipment from the weather.

I. Equipment shall be stored at the site indoors, or outdoors on pallets where approved by A/E and CM. Do not set units directly on grade.

J. Equipment shall be fully protected from moisture while being stored. Use heavy tarps with tie down straps or other means to protect the units from moisture and outdoor weather conditions.

K. All air side devices such as air handling units, VAV terminals, coils, fans, terminal heating devices, ductwork and ductwork accessories shall be shipped, received and stored in such a manner that moisture is not allowed to be exposed to any portion of the equipment. Any equipment that is found to have or have had moisture present shall be removed from the job site and replaced.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors in walls, ceilings, and floors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors for building components are specified in Division 08 Section "Access Doors and Frames." Access doors for ductwork are specified in Section 23 33 00 – Air Duct Accessories.

D. Coordination Drawings: Contractors shall produce a coordinated set of installation drawings from Project Drawings to establish the final coordinated installation elevations and routing of building services, such as but not limited to duct, pipe, wiring, conduit, cabling, and etc.
   1. Coordination drawings shall be drawn to 1/4” = 1’0” scale.
   2. All building trades shall participate; Division 23 contractor shall lead coordination, review, and produce the finished document set for review.
   3. Generally, the following installation conditions shall be met to organize the different building materials, and as otherwise noted and identified on the Project Drawings.
      a. Install Divisions 21, 22, 23, 25, 26 and 28 pipe and conduit mains first, at higher elevation(s); above duct mains and sub-mains.
      b. Install Division 23 duct mains and sub-mains, typically higher is better, and not less than 12 inches above finished ceiling elevation.
      c. Install branch duct, pipe and conduit run-outs, typically higher is better, and not less than 8 inches above the finished ceiling elevation.
      d. Equipment is expected to be at an accessible and serviceable location, typically not more than 18 inches above the finished ceiling elevation.
      e. Valves, dampers, and other manual controls shall be visible and accessible.
      f. Access of components is considered from a ladder positioned below the ceiling elevation with the operator standing appropriately atop the ladder.
   4. Generalized routing of building utilities is not expected to vary significantly from Project Drawings, but coordination with the appropriate designer(s) shall be the responsibility of the contractor to facilitate if significant deviations are necessary.
   5. A fully coordinated and detailed set of installation drawings shall be submitted for review prior to commencement of installation; equipment procurement is expected to occur simultaneously with production of the coordinated installation document set.
   6. Coordinated document set shall account for all service and maintenance requirements of the intended/expected equipment selections.
   7. Failure to complete and submit coordination drawing(s) for review prior to installation of work will result in the rejection of the coordination drawing submission(s).

E. Coordinate the use of pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

F. Contractor is responsible to coordinate requirements for access panels and doors and assign installation locations at walls, ceilings, and floors for HVAC items requiring access. Access doors for building components are specified in Division 08 Section "Access Doors and Frames." Access doors for ductwork are specified in Section 23 33 00.

G. Coordinate with the Division 26 Contractor regarding the location of all Switchboards and Switchgear. Piping shall not be run over or near any Switchboard or Switchgear. Piping or ductwork foreign to the electrical installation whose malfunction would endanger the operation of the electrical system shall not be routed through the Main Electrical Room, shall not be routed through the Main Emergency Equipment Room, and shall not be routed through the Emergency Generator Room. The exception would be statutorily required fire protection piping.
   1. Piping should be avoided over any wall mounted electrical panel with a voltage of 120 volts or higher. Obtain written approval from Owners Representative before routing piping above an electrical panel.

1.8 PROJECT CONDITIONS

A. Unless otherwise stipulated under a particular heading, the following rules relative to responsibilities of the several Contractors and subcontractors will apply.
   1. Each Contractor shall install roughing-in work pertaining to his trade for connection of Work performed under other Sections of these Specifications.

B. Certain areas will be designated for the storage of materials and equipment and cooperation/coordination with the Owner in minimizing interferences with existing operations will be mandatory.
   1. Where possible, store materials inside and protected from weather. Where necessary to store outside, elevate above grade and enclose the durable, waterproof wrapping.
   2. Follow manufacturer’s instructions for receiving, inspecting, handling, storage, and protection of products prior to final installation.

C. Equipment Clearances and Requirements
   1. Due to the possibility of restrictions imposed by space limitations, the responsibility for resolving conflicts resulting from the use of equipment other than the design basis shall rest with the equipment supplier and the Contractor. Submittals for this equipment will be considered as a statement that clearances for access, service, maintenance, etc., have been checked and found adequate.
   2. Alternate equipment or the equipment of additional manufacturers named in these documents shall meet Base Bid specifications. In the event such equipment or any equipment which the bidder proposes to furnish, deviates from the requirements of equipment first named regarding electric service, power wiring, control wiring, plumbing or piping, sound attenuation, or vibration damping, it shall be the responsibility of the bidder to include in his price a sufficient sum to cover additional costs or charges resulting there from.

D. In general, the piping and ductwork shown on the Drawings shall be considered as diagrammatic for clearness in indicating the general run and connections required, and may not be shown in its true position. The piping and ductwork and equipment may have to be offset, lowered or raised, as required, or as directed at the site in order to accommodate field conditions.

1.9 CLOSEOUT DOCUMENTS

A. After corrections and any job installation changes, the contractor shall be responsible for delivering the following closeout documents to the owner. Each set of documents shall be provided in paper copy and digital format. The digital format shall be coordinated directly with the owner. Contractor responsible for any hard drive and/or storage requirements to deliver documents. Include items specified in Division 01 Section "Operation and Maintenance Data," along with the following:
   1. Full size as-built drawings (Quantity: 1)
      a. Including ductwork, piping, temperature control schematics, etc.
   2. Complete parts list of HVAC equipment and accessories
   3. Specifications sheets

4. Operation and maintenance manuals of all new HVAC equipment
5. Refer to individual Division 23 sections for more specific requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed or exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.4 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
   5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
      h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with hinge and set screw.
      j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
      k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
      l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
   2. Existing Piping: Use the following:
      a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
      b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
      g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
      h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
      i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.

j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

B. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 DUCT SYSTEMS – COMMON REQUIREMENTS

A. Install ductwork according to the following requirements and Division 23 Sections specifying ductwork systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of ductwork systems. Indicated locations and arrangements were used to size ductwork and calculate friction loss, expansion, fan sizing, and other design considerations. Install ductwork in general location as indicated in Contract Documents unless deviations to layout are approved on Coordination Drawings. Minor offsets, lowering or raising the ductwork shall be routed to accommodate field conditions at no expense to the project.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel, and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. Coordinate ceiling mounted equipment locations to provide proper maintenance access and where possible, maintain a 24 by 24 inch clear path from the floor level to the equipment. All equipment above the ceiling shall be accessible via 10 foot (or shorter) ladder and shall be no more than 24 inches above the ceiling grid. Equipment mounted above ceilings that are greater than 10 feet high, shall have access via other means approved by the Owner, and as a minimum shall not require special lifts to access. The contractor shall coordinate with other trades to ensure that systems below the equipment (piping, cable trays, ductwork, etc.) shall not impede the service area or path to that service area. The contractor shall note service access areas on all shop drawings for ceiling mounted systems for all trades to ensure proper clearance.

3.5 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Motor shall be Premium Efficient as described in NEMA Standards Publication MG 1-2006.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Service Factor: 1.15.

C. Rotor: Random-wound, squirrel cage.

D. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

E. Temperature Rise: Match insulation rating.

F. Insulation: Class F.

G. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

H. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
   5. All motors driven by a variable frequency controller shall include a maintenance free, circumferential, conductive microfiber shaft grounding ring to discharge shaft currents to ground.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Ball valves.
2. Iron, single-flange butterfly valves.
3. Iron, grooved-end butterfly valves.
4. Bronze, grooved-end butterfly valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Iron, grooved-end swing-check valves.
8. Iron, grooved-end spring-actuated check valves.
9. Bronze globe valves.
10. Iron globe valves.
11. Lubricated plug valves.
12. Drain valves.

B. Related Sections:
1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene-propylene-diene monomer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
1. Grooved-end valves shall be of the same manufacturer as the grooved components.
2. No yellow brass containing more than 15 percent zinc.

B. ASME Compliance:
1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

B. Valve Sizes: Same as upstream piping unless otherwise indicated.

C. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
   2. Handwheel: For valves other than quarter-turn types.
   3. Handlever: For quarter-turn valves NPS 6 and smaller.
   4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
   5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle that allows operation of valve without disturbing insulation.
   2. Butterfly Valves: With extended neck.

E. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Grooved: With grooves according to AWWA C606 or copper tube dimensions.
   3. Solder Joint: With sockets according to ASME B16.18.
   4. Threaded: With threads according to ASME B1.20.1.

F. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Apollo.
      b. NIBCO INC.
      c. Crane Co.; Crane Valve Group; Jenkins Valves.
      d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.

e. Hammond Valve.
f. Jamesbury; a subsidiary of Metso Automation.
g. Kitz Corporation.
h. Marwin Valve; a division of Richards Industries.
i. Milwaukee Valve Company.
j. RuB Inc.
k. Watts

2. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: ASTM B584 C8440.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel.
j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Bray Controls; a division of Bray International.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corp.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Hammond Valve.
i. Kitz Corporation.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Norriseal; a Dover Corporation company.
m. Red-White Valve Corporation.
n. Spence Strainers International; a division of CIRCOR International.
o. Tyco Valves & Controls; a unit of Tyco Flow Control.
p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

2.4 IRON, GROOVED-END BUTTERFLY VALVES

A. 300 CWP, Iron, Grooved-End Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Anvil Gruvlok.
b. Tyco-Grinnell.
c. Kennedy Valve; a division of McWane, Inc.

d. Mueller Steam Specialty; a division of SPX Corporation.
e. NIBCO INC.
f. Shurjoint Piping Products.
g. Victaulic Company.

2. Description:
a. Standard: MSS SP-67, Type I.
b. NPS 8 and Smaller CWP Rating: 300 psig.
c. NPS 10 and Larger CWP Rating: 200 psig.
d. Body Material: Coated, ductile iron.
e. Stem: Two-piece stainless steel.
1) Stem shall be offset from the disc centerline to provide full 360 degree circumferential seating.
f. Disc: Coated, ductile iron, aluminum-bronze, or stainless steel.
g. Seal: EPDM.

2.5 BRONZE, GROOVED-END BUTTERFLY VALVES

A. 300 CWP, Iron, Bronze Body Grooved-End Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Victaulic Company
b. Tyco-Grinnell
c. Anvil Gruvlok
2. Description
a. CWP Rating: 300 psig.
b. Body Material: Cast bronze.
c. Stem: Integrally cast with disc.
d. Disc: EPDM coated, ductile iron.

2.6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.
2. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.

d. Crane Co.; Crane Valve Group; Stockham Division.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Zy-Tech Global Industries, Inc.

2. Description:
a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.7 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Kitz Corporation.
f. Legend Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Sure Flow Equipment Inc.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
m. Zy-Tech Global Industries, Inc.
2. Description:
a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

B. Class 250, Iron Swing Check Valves with Metal Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
c. NPS 14 to NPS 24, CWP Rating: 300 psig.
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.

h. Gasket: Asbestos free.

2.8 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Anvil Gruvlok.
b. Shurjoint Piping Products.
c. Tyco-Grinnell.
d. Victaulic Company.
2. Description:
a. CWP Rating: 300 psig.
b. Body Material: ASTM A 536, ductile iron.
c. Seal: EPDM.
d. Disc: Spring operated, ductile iron or stainless steel.

2.9 IRON, GROOVED-END SPRING-ACTUATED CHECK VALVES

A. 300 CWP, Iron, Grooved-End Spring-Actuated Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Victaulic Company
b. Tyco-Grinnell.
c. Anvil Gruvlok
2. Description
a. CWP Rating: 300 psig.
b. Body Material: ASTM A536, ductile iron.
c. Seal: EPDM.
d. Disc:
1) NPS 2-1/2 and NPS 3: Aluminum-bronze.
2) NPS 4 through NPS 12: Elastomer coated ductile iron.
3) NPS 14 through NPS 24: Dual stainless steel disc.
e. Spring and Shaft: Stainless steel.

2.10 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
j. Zy-Tech Global Industries, Inc.
2. Description:
a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

2.11 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Crane Co.; Crane Valve Group; Stockham Division.
      d. Hammond Valve.
      e. Kitz Corporation.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Powell Valves.
      i. Red-White Valve Corporation.
      j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      k. Zy-Tech Global Industries, Inc.
   2. Description:
      a. Standard: MSS SP-85, Type I.
      b. CWP Rating: 200 psig.
      c. Body Material: ASTM A 126, gray iron with bolted bonnet.
      d. Ends: Flanged.
      e. Trim: Bronze.
      f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Crane Co.; Crane Valve Group; Stockham Division.
      d. Hammond Valve.
      e. Milwaukee Valve Company.
      f. NIBCO INC.
      g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      a. Standard: MSS SP-85, Type I.
      b. CWP Rating: 500 psig.
      c. Body Material: ASTM A 126, gray iron with bolted bonnet.
      d. Ends: Flanged.
      e. Trim: Bronze.
      f. Packing and Gasket: Asbestos free.

2.12 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Nordstrom Valves, Inc.
   2. Description:
      a. Standard: MSS SP-78, Type II.
      b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
      c. NPS 14 to NPS 24, CWP Rating: 150 psig.
      d. Body Material: ASTM A 48or ASTM A 126, cast iron with lubrication-sealing system.
      e. Pattern: Regular or short.
      f. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Nordstrom Valves, Inc.

2. Description:
   a. Standard: MSS SP-78, Type II.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. NPS 14 to NPS 24, CWP Rating: 150 psig.
   d. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
   e. Pattern: Regular or short.
   f. Plug: Cast iron or bronze with sealant groove.

2.13 DRAIN VALVE (HOSE END)

A. For Low Pressure Drainage Service
   1. Threaded ends 2 inches and smaller: Class 125, bronze body, screwed bonnet, rising stem, composition disc, 3/4 inch hose outlet connection with cap and chain.
   2. Soldered ends 2 inches and smaller: Class 125 bronze body, screwed bonnet, rising stem, composition disc, 3/4 inch hose outlet connection with cap and chain.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Examine grooved-ends for form and cleanliness. Grooved-ends shall be clean and free from indentations and projections in the area from valve end to groove.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions, grooved joint couplings or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball, butterfly, or globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

G. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball or butterfly.
   2. Butterfly Valve Dead-End Service: Grooved-end or single-flange (lug) type.
   3. Throttling Service: Globe, ball, or butterfly valves.
   4. Pump-Discharge Check Valves:
      a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
      b. NPS 2-1/2 and Larger: Iron swing or spring-actuated check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   6. For Steel Piping, NPS 5 and Larger: Flanged ends.
   7. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.
   8. For NPS 2 and Smaller: Valve ends may be press fit in lieu of soldered copper or threaded steel.

3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Ball Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Ball Valves:
      a. Two-piece, full port, with press fit ends.
   3. Bronze Swing Check Valves: Class 125, bronze disc.
   4. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:
   1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
   2. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 24: 300 CWP.
   3. Iron Swing Check Valves: Class 250, metal seats.
   4. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
      a. NPS 3 to NPS 12: 300 CWP.
      b. NPS 14 to NPS 24: 230 CWP.
   5. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 250.

3.6 DRAIN VALVE SCHEDULE

A. At all points in the piping system.

B. Where indicated on the drawings.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Duct hangers and supports.
   8. Structural roof curbs.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Division 07 Section “Roof Accessories” for general information concerning roof accessories.
   3. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
   4. Division 23 Section "Vibration Controls for HVAC Piping and Equipment" for vibration isolation devices.
   5. Division 23 Section(s) "Metal Ducts" and for duct hangers and supports.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

D. Provide additional supplemental steel as required to support equipment, ductwork, piping, etc. from structure above.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.2, "Structural Welding Code--Aluminum."
   3. AWS D1.3, "Structural Welding Code--Sheet Steel."
   4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
   5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
   1. B-Line Systems, Inc.; a division of Cooper Industries.
   2. Carpenter & Paterson, Inc.
   3. Empire Industries, Inc.
   4. ERICO/Michigan Hanger Co.
   5. Globe Pipe Hanger Products, Inc.
   6. Grinnell Corp.
   7. National Pipe Hanger Corporation.
   8. PHD Manufacturing, Inc.
   9. PHS Industries, Inc.
   10. Piping Technology & Products, Inc.
   11. Anvil International

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:
   1. B-Line Systems, Inc.; a division of Cooper Industries.
   2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
   3. GS Metals Corp.
   4. Power-Strut Div.; Tyco International, Ltd.
   5. Thomas & Betts Corporation.
   6. Tolco Inc.
   7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. PHS Industries, Inc.
   4. Pipe Shields, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers:
      a. B-Line Systems, Inc.; a division of Cooper Industries.
      b. Empire Industries, Inc.
      c. Hilti, Inc.
      d. ITW Ramset/Red Head.
      e. MKT Fastening, LLC.
      f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
   1. Manufacturers:
      a. ERICO/Michigan Hanger Co.
      b. MIRO Industries.

2.8 DUCT HANGERS AND SUPPORTS

A. Support horizontal ductwork runs with suitable strap or trapeze hangers. When weight of duct between hangers does not exceed 60 pounds, hangers shall be 1 inch wide by 18 gauge. For greater weights, use trapeze hangers, as approved by A/E.

B. Contractor may use load rated cable suspension system. Suspension system shall have a specified manufacturers safe working load and supplemental safety factor of at least five times the safe working load.
   1. Suspension system shall be verified by SMACNA Testing and Research Institute to be in compliance with SMACNA Duct Construction Standards Guidelines (1995 CH.4).

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

2.10 ROOF CURBS/EQUIPMENT SUPPORTS

A. Roof curbs with vibration isolators are specified in Division 23 Section “Vibration Controls for HVAC Piping and Equipment”.

B. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.

C. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
   1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
      a. Materials: ASTM C1071, Type I or II.
      b. Thickness: 1-1/2 inches.
   2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      a. Liner Adhesive: Comply with ASTM C916, Type I.
      b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
      c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
      d. Liner Adhesive: Comply with ASTM C916, Type I.

e. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support. Coordinate with roofing contractor.
f. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
g. Fabricate equipment supports to minimum height of 12 inches above finished roof surface, unless otherwise indicated. Refer to equipment schedules.
h. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.

16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
6. Swivel connections shall be utilized for attachment to sloping structure. Threaded rod shall not be bent.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.

b. Medium (MSS Type 32): 1500 lb.
c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction. The use of powder-actuated fasteners or mechanical-expansion anchors may only be used after approval from the structural engineer.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 29

SECTION 23 05 48 – VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Isolation pads.
   2. Isolation mounts.
   3. Spring isolators.
   4. Elastomeric hangers.
   5. Spring hangers.
   6. Restrained vibration isolation roof-curb rails.

1.2 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Welding certificates.

B. Field quality-control test reports.

1.5 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ace Mountings Co., Inc.
   2. Amber/Booth Company, Inc.
   3. California Dynamics Corporation.
   4. Isolation Technology, Inc.
   5. Kinetics Noise Control.
   6. Mason Industries.
   7. Vibration Eliminator Co., Inc.
   8. Vibration Isolation.
   9. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
   1. Resilient Material: Oil- and water-resistant neoprene.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
   1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
   1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
   6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with limit-stop restraint.
   1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
   2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
   3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

G. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

H. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
   7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

J. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Amber/Booth Company, Inc.
   2. California Dynamics Corporation.
   3. Isolation Technology, Inc.
   4. Kinetics Noise Control.
   5. Mason Industries.

6. Vibration Eliminator Co., Inc.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:
   1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

E. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

G. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust air-spring leveling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01 Section "Demonstration And Training."

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.
6. Warning tags.
7. Ceiling tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering

for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

A. Material: Printed plastic with contact-type, permanent-adhesive backing.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

F. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: 3 by 5-1/4 inches minimum.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Yellow background with black lettering.

2.7 CEILING TAGS

A. Ceiling Tags
   1. Additional location and identification of plumbing and HVAC system valves shall be accomplished using 1/2 inch diameter colored, pressure-sensitive adhesive paper circles. Apply circles to ceiling grid below location of system valves per following color code:

Heating Hot Water	=	Orange
Chilled Water – Chiller Loop	=	Green
Chilled Water – Chilled Beam Loop	=	Yellow
VAV Units	=	VAV Unit Label
In-Line Exhaust Fan	=	Exhaust Unit Label
Duct Static Pressure Sensor	=	Brown
Hydronic Differential Pressure Transmitter	=	Purple
Smoke Damper	=	SD
Fire Damper	=	FD
Fire/Smoke Damper	=	FD/SD
Duct Mounted Heating Coils	=	Heating Coil Label

   2. Circles which have been applied to ceiling pads are not acceptable

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment, along with all associated devices such as starters, disconnect switches, etc.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe band colors and letters for HVAC Piping Systems shall be as follows:

1.	Hot water heating supply	Yellow-red	H.W.H.S.
2.	Hot water return	Yellow-Orange	H.W.H.R.

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels and directional arrows with permanent adhesive on air ducts.
   1. Duct labels representative of the duct service:
      a. Supply
      b. Return
      c. Relief
      d. Exhaust
      e. Outside Air
      f. Laboratory Exhaust

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 CEILING TAG INSTALLATION

A. Install tags below HVAC systems, equipment, valves, and accessories for ease of location.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Section 23 08 00 – Commissioning of HVAC Systems.

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for the following:
   1. Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume systems.
      c. Exhaust systems.
   2. Hydronic Piping Systems:
      a. Primary-secondary systems.
   3. HVAC equipment quantitative-performance settings.
   4. Existing systems TAB.
   5. Verifying that automatic control devices are functioning properly.
   6. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.

J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.

K. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

L. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

M. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

N. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

O. TAB: Testing, adjusting, and balancing.

P. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

Q. Test: A procedure to determine quantitative performance of systems or equipment.

R. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

B. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems," NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing."

D. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's " Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, " Section II, " Required Instrumentation for NEBB Certification."

E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

F. Establish setpoints and calibrate controls. Coordinate with the Temperature Control Contractor and HVAC Contractor.

G. Mark final control damper and volume damper positions.

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Coordinate/cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Coordinate/cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

D. The Building Automation System shall be fully operational and adjustable before final balancing can be accomplished.

1.8 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
   1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
   1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of Contract.

2. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are installed as required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

I. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

K. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

L. Examine strainers for clean screens and proper perforations.

M. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

O. Examine system pumps to ensure absence of entrained air in the suction piping.

P. Examine equipment for installation and for properly operating safety interlocks and controls.

Q. Examine automatic temperature system components to verify the following:
1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.

4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.

R. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.
9. Relief air system adjustment.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Identify fan and motor RPM, motor current and voltage, fan coil, and filter status.

I. Check dampers for proper position to achieve desired airflow path.

J. Check for airflow blockages.

K. Check condensate drains for proper connections and functioning.

L. Check for proper sealing of air-handling unit components.

M. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure fan static pressures to determine actual static pressure as follows:
      a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
   3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
   4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
   5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
   6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
   7. Coordinate with Division 23 Contractor to provide correct sheave size to allow fan motor to produce full rated horsepower with the (VFC) variable frequency controller at 100 percent speed. The maximum design airflow shall be accommodated by reducing the fan speed through the VFC. Make required adjustments to pulley sizes, motor sizes, and electrical connections as required.
   8. Record air handling unit airflow during normal unit occupied and unoccupied operation and during economizer operation.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust air handling unit fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure fan static pressures to determine actual static pressure as follows:
      a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and treating equipment.
      a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
   3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
   4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
   5. Provide correct sheave size to allow fan motor to produce full rated horsepower with the (VFC) variable frequency controller at 100 percent speed. The maximum design airflow shall be accommodated by reducing the fan speed through the VFC. Make required adjustments to pulley sizes, motor sizes, and electrical connections as required.
   6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers above fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
   7. Record air handling unit airflow during normal unit occupied and unoccupied operation and during economizer operation.

B. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

C. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
   2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   3. Measure total system airflow. Adjust to within indicated airflow.
   4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
   5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
      a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
   6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
   7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
   8. Record the final fan performance data.

D. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Balance systems similar to constant-volume air systems.
   2. Set terminal units and supply fan at full-airflow condition.
   3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
   4. Readjust fan airflow for final maximum readings.
   5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
   6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
   7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
      a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
   8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

E. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
   2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
   3. Set terminal units at full-airflow condition.

4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.7 PROCEDURES FOR EXHAUST AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure fan static pressures to determine actual static pressure.
   2. Compare design data with installed conditions to determine variations in design static pressure versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
   3. Obtain approval from A/E for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
   4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
   5. Coordinate with Division 23 Contractor to provide correct sheave size to allow fan motor to produce full rated horsepower with the (VFC) variable frequency controller at 100 percent speed. The maximum design airflow shall be accommodated by reducing the fan speed through the VFC. Make required adjustments to pulley sizes, motor sizes, and electrical connections as required.
   6. Record air handling unit airflow during normal unit occupied and unoccupied operation and during economizer operation.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air devices without making adjustments.
   1. Measure air devices using a direct-reading hood or outlet manufacturer’s written instructions and calculating factors.

D. Adjust air devices for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check expansion tank liquid level.
   3. Check makeup-water-station pressure gauge for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation and set at indicated flow.
   5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   6. Set system controls so automatic valves are wide open to heat exchangers.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   8. Check air vents for a forceful liquid flow exiting from vents when manually operated.
   9. Determine optimum pressure setting of differential pressure transmitter. Coordinate with the Temperature Control Contractor.
   10. All coils with 3-way temperature control valves have manual balance valves on the bypass leg. Adjust the pressure drop through the bypass leg to match the pressure drop through the coil at full flow.

3.9 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
   1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gauge heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
   3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
   4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
   1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
   1. Determine the balancing station with the highest percentage over indicated flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
   3. Record settings and mark balancing devices.
   4. When automatic flow control valves are used, measure pressure drop across valve. Verify pressure drop is within valve operating range. Submit pressure and waterflow results in final report schedule.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

B. Balance pump flow with all valves to the 100 percent open location.

C. Triple-duty valve shall be fully open.

D. Adjust pump flow by reducing (VFC) variable frequency-controller speed to attain scheduled flow rate.

3.11 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

A. Balance the primary system crossover flow first, then balance the secondary system.

B. Refer to procedures for variable flow hydronic systems.

3.12 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.13 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.
6. Measure cooling tower pump discharge pressure.
7. Adjust water level and feed rate of makeup-water system.

3.14 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.15 PROCEDURES FOR BOILERS

A. If hydronic, measure entering- and leaving-water temperatures and water flow.

B. Minimum and maximum water flow.

C. Water pressure drop.

D. If steam, measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.

3.16 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:
1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Electric-Heating Coils: Measure the following data for each coil:
1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Refrigerant Coils: Measure the following data for each coil:
1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.17 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.18 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.

B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.

C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
   1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
   2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
   3. Test room pressurization first, then zones, and finish with building pressurization.

D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.

E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
   1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
   2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test overpressurization and underpressurization, and observe and report on the system's ability to revert to the set point.
   3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.

F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.

G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

3.19 PROCEDURES FOR SOUND-LEVEL MEASUREMENTS

A. Perform sound-pressure-level measurements with an octave-band analyzer complying with ANSI S1.4 for Type 1 sound-level meters and ANSI S1.11 for octave-band filters. Comply with requirements in ANSI S1.13, unless otherwise indicated.

B. Calibrate sound meters before each day of testing. Use a calibrator provided with the sound meter complying with ANSI S1.40 and that has NIST certification.

C. Use a microphone that is suitable for the type of sound levels measured. For areas where air velocities exceed 100 fpm, use a windscreen on the microphone.

D. Perform sound-level testing after air and water balancing and equipment testing are complete.

E. Close windows and doors to the space.

F. Perform measurements when the space is not occupied and when the occupant noise level from other spaces in the building and outside are at a minimum.

G. Clear the space of temporary sound sources so unrelated disturbances will not be measured. Position testing personnel during measurements to achieve a direct line-of-sight between the sound source and the sound-level meter.

H. Take sound measurements at a height approximately 48 inches above the floor and at least 36 inches from a wall, column, and other large surface capable of altering the measurements.

I. Take sound measurements in dBA and in each of the 8 unweighted octave bands in the frequency range of 63 to 8000 Hz.

J. Take sound measurements with the HVAC systems off to establish the background sound levels and take sound measurements with the HVAC systems operating.
   1. Calculate the difference between measurements. Apply a correction factor depending on the difference and adjust measurements.

K. Perform sound testing at <**Insert number**> locations on Project for each of the following space types. For each space type tested, select a measurement location that has the greatest sound level. If testing multiple locations for each space type, select at least one location that is near and at least one location that is remote from the predominant sound source.
   1. Private office.
   2. Open office area.
   3. Conference room.
   4. Auditorium/large meeting room/lecture hall.
   5. Classroom/training room.
   6. Patient room/exam room.
   7. Sound or vibration sensitive laboratory.
   8. Hotel room/apartment.
   9. Each space with a noise criterion of RC or NC 25 or lower.
   10. Each space with an indicated noise criterion of RC or NC 35 and lower that is adjacent to a mechanical equipment room or roof mounted equipment.
   11. Inside each mechanical equipment room.

3.20 PROCEDURES FOR SMOKE-CONTROL SYSTEM TESTING

A. Before testing smoke-control systems, verify that construction is complete and verify the integrity of each smoke-control zone boundary. Verify that windows and doors are closed and that applicable safing, gasket, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.

B. Measure and record wind speed and direction, outside-air temperature, and relative humidity on each test day.

C. Measure, adjust, and record airflow of each smoke-control system with all fans that are a part of the system operating as intended by the design.

D. Measure, adjust, and record the airflow of each fan. For ducted systems, measure the fan airflow by duct Pitot-tube traverse.

E. After air balancing is complete, perform the following pressurization testing for each smoke-control zone in the system:
   1. Verify the boundaries of each smoke-control zone.
   2. With the HVAC systems in their normal mode of operation and smoke control not operating, measure and record the pressure difference across each smoke-control zone. Make measurements after closing doors that separate the zones. Make one measurement across each door. Clearly indicate the high and low pressure side of each door.
   3. With the system operating in the smoke-control mode and with each zone in the smoke-control system activated, perform the following:
      a. Measure and record the pressure difference across each door that separates the smoke zone from adjacent zones. Make measurements with doors that separate the smoke zone from the other zones closed. Clearly indicate the high and low pressure side of the door. Doors that have a tendency to open slightly due to the pressure difference should have one pressure measurement made while held closed and another measurement made with the door open.
      b. Continue to activate each separate zoned smoke-control system and make pressure difference measurements.
      c. After testing a smoke zone's smoke-control system, deactivate the HVAC systems involved and return them to their normal operating mode before activating another zone's smoke-control system.

d. Verify that controls necessary to prevent excessive pressure differences are functional.

F. Operational Tests:
1. Check the proper activation of each zoned smoke-control system in response to all means of activation, both automatic and manual.
2. Check automatic activation in response to fire alarm signals received from the building's fire alarm and detection system. Initiate a separate alarm for each means of activation to ensure that the proper operation of the correct zoned smoke-control system occurs.
3. Check and record the proper operation of fans, dampers, and related equipment as outlined below for each separate zone of the smoke-control system.
   a. Fire zone in which a smoke-control system automatically activates.
   b. Type of signal that activates a smoke-control system, such as pull station, sprinkler water flow, or smoke detector.
   c. Smoke zone(s) where maximum mechanical exhaust to the outside is implemented and no supply air is provided.
   d. Positive pressure smoke-control zone(s) where maximum air supply is implemented and no exhaust to the outside is provided.
   e. Fan(s) "ON" as required to implement the smoke-control system. Multiple- or variable-speed fans should be further noted as "MAX. VOLUME" to verify that the intended control configuration is achieved.
   f. Fan(s) "OFF" as required to implement the smoke-control system.
   g. Damper(s) "OPEN" where maximum airflow must be achieved.
   h. Damper(s) "CLOSED" where no airflow should take place.
   i. Auxiliary functions to achieve the smoke-control system configuration such as changes or override of normal operating pressure and temperature-control set points.
   j. If standby power is provided for the smoke-control system, test to verify that the system functions while operating under both normal and standby power.

G. Conduct additional tests required by authorities having jurisdiction. Unless required by authorities having jurisdiction, perform testing without the use of smoke or products that simulate smoke.

H. Prepare a complete report of observations, measurements, and deficiencies.

3.21 PROCEDURES FOR INDOOR-AIR QUALITY MEASUREMENTS

A. After contractors are finished and air balancing is complete and with HVAC systems operating at indicated conditions, perform indoor-air quality testing. New pre and final filters shall be installed prior to testing.

B. Refer to Division 01 Section 018119 – Indoor Air Quality Requirements for additional information.

C. Observe and record the following conditions for each HVAC system:
1. The distance between the outside-air intake and the closest exhaust fan discharge, cooling tower, flue termination, or vent termination.
2. Specified filters are installed. Check for leakage around filters.
3. Cooling coil drain pans have a positive slope to drain.
4. Cooling coil condensate drain trap maintains an air seal.
5. Evidence of water damage.
6. Insulation in contact with the supply, return, and outside air is dry and clean.

D. Measure and record indoor conditions served by each HVAC system. Make measurements at multiple locations served by the system if required to satisfy the following:
1. Most remote area.
2. One location per floor.
3. One location for every 5000 sq. ft.
4. Locations shall be between 3 feet and 6 feet above the floor.

E. Measure and record the following indoor conditions for each location two times at two-hour intervals, and in accordance with ASHRAE 113:
   1. Temperature.
   2. Relative humidity.
   3. Air velocity.
   4. Concentration of carbon dioxide (ppm).
   5. Concentration of carbon monoxide (ppm).
   6. Nitrogen oxides (ppm).
   7. Formaldehyde (ppm).
   8. Particulates (PM10).
   9. Total volatile organic compounds (TVOC).
   10. 4-Phenylcylohexene (4-PCH).

3.22 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
   1. Measure and record the operating speed, airflow, and static pressure of each fan.
   2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
   3. Check the refrigerant charge.
   4. Check the condition of filters.
   5. Check the condition of coils.
   6. Check the operation of the drain pan and condensate drain trap.
   7. Check bearings and other lubricated parts for proper lubrication.
   8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
   1. New filters are installed.
   2. Coils are clean and fins combed.
   3. Drain pans are clean.
   4. Fans are clean.
   5. Bearings and other parts are properly lubricated.
   6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
   1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
   2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
   3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
   4. Air balance each air outlet and inlet.

3.23 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.24 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: 0 to plus 10 percent.
2. Air Outlets and Inlets: 0 plus 10 percent.
3. Heating-Water Flow Rate: 0 to plus 10 percent.
4. Cooling-Water Flow Rate: 0 to plus 10 percent.

3.25 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.26 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
2. Name and address of TAB firm.
3. Project name.

4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    j. Number of belts, make, and size.
    k. Number of filters, type, and size.
2. Motor Data:
    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.

d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat coil static-pressure differential in inches wg.
g. Cooling coil static-pressure differential in inches wg.
h. Heating coil static-pressure differential in inches wg.
i. Outside airflow in cfm.
j. Return airflow in cfm.
k. Outside-air damper position.
l. Return-air damper position.
m. Vortex damper position.

G. Apparatus-Coil Test Reports:
1. Coil Data:
a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outside-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.

H. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btuh.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.

d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btuh.
i. High-fire fuel input in Btuh.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btuh.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btuh.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.
3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

J. Round, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:
1. Unit Data:
a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.

f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft.

2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

M. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Unit make and model number.
d. Compressor make.
e. Compressor model and serial numbers.
f. Refrigerant weight in lb.
g. Low ambient temperature cutoff in deg F.

2. Test Data (Indicated and Actual Values):
a. Inlet-duct static pressure in inches wg.
b. Outlet-duct static pressure in inches wg.
c. Entering-air, dry-bulb temperature in deg F.
d. Leaving-air, dry-bulb temperature in deg F.
e. Condenser entering-water temperature in deg F.
f. Condenser leaving-water temperature in deg F.
g. Condenser-water temperature differential in deg F.
h. Condenser entering-water pressure in feet of head or psig.
i. Condenser leaving-water pressure in feet of head or psig.
j. Condenser-water pressure differential in feet of head or psig.
k. Control settings.
l. Unloader set points.
m. Low-pressure-cutout set point in psig.
n. High-pressure-cutout set point in psig.
o. Suction pressure in psig.
p. Suction temperature in deg F.
q. Condenser refrigerant pressure in psig.
r. Condenser refrigerant temperature in deg F.
s. Oil pressure in psig.
t. Oil temperature in deg F.

u. Voltage at each connection.
v. Amperage for each phase.
w. Kilowatt input.
x. Crankcase heater kilowatt.
y. Number of fans.
z. Condenser fan rpm.
aa. Condenser fan airflow rate in cfm.
bb. Condenser fan motor make, frame size, rpm, and horsepower.
cc. Condenser fan motor voltage at each connection.
dd. Condenser fan motor amperage for each phase.

N. Heat-Exchanger/Converter Test Reports: For steam and hot-water heat exchangers, include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.
f. Ratings.
2. Primary Water Test Data (Indicated and Actual Values):
a. Entering-water temperature in deg F.
b. Leaving-water temperature in deg F.
c. Entering-water pressure in feet of head or psig.
d. Water pressure differential in feet of head or psig.
e. Water flow rate in gpm.
3. Secondary Water Test Data (Indicated and Actual Values):
a. Entering-water temperature in deg F.
b. Leaving-water temperature in deg F.
c. Entering-water pressure in feet of head or psig.
d. Water pressure differential in feet of head or psig.
e. Water flow rate in gpm.

O. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model and serial numbers.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.
2. Test Data (Indicated and Actual Values):
a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.

e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

P. Boiler Test Reports:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.
f. Fuel type and input in Btuh.
g. Number of passes.
h. Ignition type.
i. Burner-control types.
j. Voltage at each connection.
k. Amperage for each phase.
2. Test Data (Indicated and Actual Values):
a. Operating pressure in psig.
b. Operating temperature in deg F.
c. Entering-water temperature in deg F.
d. Leaving-water temperature in deg F.
e. Number of safety valves and sizes in NPS.
f. Safety valve settings in psig.
g. High-limit setting in psig.
h. Operating-control setting.
i. High-fire set point.
j. Low-fire set point.
k. Voltage at each connection.
l. Amperage for each phase.
m. Draft fan voltage at each connection.
n. Draft fan amperage for each phase.
o. Manifold pressure in psig.

Q. Sound Measurement Reports: Record sound measurements on octave band and dBA test forms and on an NC or RC chart indicating the decibel level measured in each frequency band for both "background" and "HVAC system operating" readings. Record each tested location on a separate NC or RC chart. Record the following on the forms:
1. Date and time of test. Record each tested location on its own NC curve.
2. Sound meter manufacturer, model number, and serial number.
3. Space location within the building including floor level and room number.
4. Diagram or color photograph of the space showing the measurement location.
5. Time weighting of measurements, either fast or slow.
6. Description of the measured sound: steady, transient, or tonal.
7. Description of predominant sound source.

R. Indoor-Air Quality Measurement Reports for Each HVAC System:
1. HVAC system designation.
2. Date and time of test.
3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
4. Room number or similar description for each location.
5. Measurements at each location.
6. Observed deficiencies.

S. Instrument Calibration Reports:
   1. Report Data:
      a. Instrument type and make.
      b. Serial number.
      c. Application.
      d. Dates of use.
      e. Dates of calibration.

3.27 INSPECTIONS

A. Initial Inspection:
   1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
   2. Randomly check the following for each system:
      a. Measure airflow of at least 10 percent of air outlets.
      b. Measure water flow of at least 5 percent of terminals.
      c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
      d. Measure sound levels at two locations.
      e. Measure space pressure of at least 10 percent of locations.
      f. Verify that balancing devices are marked with final balance position.
      g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:
   1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Engineer.
   2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner or Architect or Commissioning Agent.
   3. Engineer shall select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
   4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
   5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
   6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
   7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.28 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

C. 11 Month Warranty Walk: TAB to perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to report unusual conditions with recommendations of adjustments. TAB Contractor shall allow two days for this work.

END OF SECTION 23 05 93

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Cellular glass.
      b. Flexible elastomeric.
      c. Mineral fiber.
   2. Fire-rated insulation systems.
   3. Insulating cements.
   4. Adhesives.
   5. Mastics.
   6. Sealants.
   7. Factory-applied jackets.
   8. Field-applied fabric-reinforcing mesh.
   9. Field-applied cloths.
   10. Field-applied jackets.
   11. Tapes.

B. Related Sections:
   1. Division 23 Section "Metal Ducts" for duct liners.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. “K” Vlaue: 0.23 at 75 degrees F (0.033 at 24 degrees C.), factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
    a. Cell-U-Foam Corporation; Ultra-CUF.
    b. Pittsburgh Corning Corporation; Foamglas Super K.
    c. Superior Plus Construction Products Corporation.
2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. “K” Value: 0.28 at 75 degrees F (0.04 at 24 degrees C.).
1. Products: Subject to compliance with requirements, provide one of the following:
    a. Aeroflex USA Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
    d. Armstrong
    e. Certainteed
    f. Johns Manville
    g. Knauf Insulation
    h. Owens Corning

i. Rubatex Corp.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. “K” Value: 0.24 at 75 degrees F (0.35 at 24 degrees C.), factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap.
   e. Owens Corning; All-Service Duct Wrap.

I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. “K” Value: 0.23 at 75 degrees F (0.033 at 24 degrees C.). For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; Commercial Board.
   b. Fibrex Insulations Inc.; FBX.
   c. Johns Manville; 800 Series Spin-Glas.
   d. Knauf Insulation; Insulation Board.
   e. Manson Insulation Inc.; AK Board.
   f. Owens Corning; Fiberglas 700 Series.

J. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Johns Manville; Micro-Lok.
   c. Knauf Insulation; 1000 Pipe Insulation.
   d. Manson Insulation Inc.; Alley-K.
   e. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. “K” Value: 0.23 at 75 degrees F (0.033 at 24 degrees C.).Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Manson Insulation Inc.; AK Flex.
   e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; FlameChek.
      b. Johns Manville; Firetemp Wrap.
      c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
      d. Thermal Ceramics; FireMaster Duct Wrap.
      e. 3M; Fire Barrier Wrap Products.
      f. Unifrax Corporation; FyreWrap.
      g. Vesuvius; PYROSCAT FP FASTR Duct Wrap.

2.3 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Insulco, Division of MFS, Inc.; Triple I.
      b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
      c. Rock Wool Manufacturing Company; Delta One Shot.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Insulco, Division of MFS, Inc.; SmoothKote.
      b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
      c. Rock Wool Manufacturing Company; Delta One Shot.

2.4 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
   1. For indoor applications, adhesive shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Cellular-GlassAdhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-96.
      b. Foster Products Corporation, H. B. Fuller Company; 81-33.
      c. Bakor; 830-05.

C. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA Inc.; Aeroseal.
      b. Armacell LCC; 520 Adhesive.
      c. Foster Products Corporation, H. B. Fuller Company; 85-75.
      d. RBX Corporation; Rubatex Contact Adhesive.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-82.
      b. Foster Products Corporation, H. B. Fuller Company; 85-20.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.

e. Mon-Eco Industries, Inc.; 22-25.

E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

F. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Red Devil, Inc.; Celulon Ultra Clear.
e. Speedline Corporation; Speedline Vinyl Adhesive.

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.

d. Mon-Eco Industries, Inc.; 55-70.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:
1. Joint Sealants for Cellular-Glass: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.
f. Vimasco Corporation; 750.
2. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
   4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
   5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Zeston.
      b. P.I.C. Plastics, Inc.; FG Series.
      c. Proto PVC Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: White.
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
   5. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; Metal Jacketing Systems.
      b. PABCO Metals Corporation; Surefit.
      c. RPR Products, Inc.; Insul-Mate.
   2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
      a. Factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
      d. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.
      e. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
         2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
         3) Tee covers.
         4) Flange and union covers.
         5) End caps.
         6) Beveled collars.
         7) Valve covers.

8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white or stucco-embossed aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Polyguard; Alumaguard 60.

F. Self-Adhesive Indoor/Outdoor Jacket (Non Asphaltic): Vapor barrier and waterproofing jacketing for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low temperature, acrylic, pressure sensitive adhesive; outer aluminum surface coated with UV resistant coating for protection from environmental contaminants. Permeance: 0.00 perm as tested by ASTM F 1249. Flame Spread <25, Smoke Developed <50 tested by ASTM E84. Aluminum finish. [Embossed] [Smooth].
1. Products: Subject to compliance with requirements, provide one of the following:
a. Foster Brand; Vapor Fas 62-05.
b. Ventureclad 1577CW.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.

5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   4. Manholes.
   5. Handholes.
   6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT INSULATION INSTALLATION

A. Mineral Fiber, Pipe Insulation Installation: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. Do not overcompress insulation during installation.
    d. Impale insulation over anchor pins and attach speed washers.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

6. Where insulation hangers on equipment are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Insulation Installation on Pumps for Heating Water:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum, at least 0.050 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions for Heating Water.
1. Install insulation over piping, fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gauges, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.11 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.12 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in nonconditioned space.
4. Indoor, exposed return located in nonconditioned space.
5. Indoor, concealed exhaust or relief between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust or relief between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply and return. Refer to metal duct specification section 23 31 13.
8. Outdoor, exposed supply and return. Refer to metal duct specification section 23 31 13.
9. Indoor, rectangular and round supply duct liner as denoted in metal duct specification.

B. Items Not Insulated:
1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.13 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, rectangular, round and flat-oval, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

B. Concealed, rectangular, round and flat-oval, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

C. Concealed, rectangular, round and flat-oval, exhaust-air and relief-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

D. Concealed, supply-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

E. Concealed, outdoor-air plenum insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

F. Concealed, exhaust-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

G. Exposed, rectangular, round and flat-oval, supply-air duct insulation in unconditioned spaces shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

H. Exposed, rectangular, round and flat-oval, outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

I. Exposed, rectangular, round and flat-oval, exhaust-air or relief air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

J. Exposed, supply-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

K. Exposed, outdoor-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

L. Exposed, exhaust-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

3.14 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Chillers: Factory insulated.

D. Heat-exchanger (water-to-water for cooling service) insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber Pipe and Tank: 1 inch thick.

E. Heat-exchanger (water-to-water for heating service) insulation shall be the following:
1. Mineral-Fiber Pipe and Tank: 2 inches thick.

F. Steam-to-hot-water converter insulation shall be the following:
1. Mineral-Fiber Pipe and Tank: 2 inches thick.

G. Chilled-water pump insulation shall be the following:
1. Flexible Elastomeric: 1 inch thick.

H. Dual-service heating and cooling pump insulation shall be the following:
1. Flexible Elastomeric: 1 inch thick.

I. Heating and chilled-water expansion/compression tank insulation shall be the following:
1. Flexible Elastomeric: 1 inch thick.

J. Dual-service heating and cooling expansion/compression tank insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.

K. Heating and chilled-water air-separator insulation shall be the following:
1. Flexible Elastomeric: 1 inch thick.

L. Dual-service heating and cooling air-separator insulation shall be one of the following:
1. Flexible Elastomeric: 1 inch thick.

M. Heating and chilled water piping system filter-housing insulation shall be the following:
1. Flexible Elastomeric: 1 inch thick.

N. VAV terminal unit coil sections shall be the following:
1. Mineral Fiber Blanket: 1-1/2 inches thick and 0.75 lb./cu.ft. nominal density.

3.15 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.16 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 3/4 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F and below:
1. NPS 1-1/2 and Smaller: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.
2. NPS 2 inch and Larger: Insulation shall be the following:
a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

C. Refrigerant Liquid, Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 1-1/2 inch thick.

3.17 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:
1. None.

D. Ducts and Plenums, Exposed:
1. None.

E. Equipment, Concealed:
1. None.

F. Equipment, Exposed:
1. None.

G. Piping, Concealed:
1. None.

H. Piping, Exposed (in Finished Spaces):
1. PVC: 30 mils thick.

3.18 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Rectangular and Round Ducts and Plenums Concealed

1. Self-Adhesive Outdoor Jacket: 60-mil laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross laminated polyethylene film covered with white aluminum-foil facing or 5 ply, non asphaltic, laminated aluminum and polyester film with pressure sensitive adhesive.

D. Rectangular and Round Ducts and Plenums, Exposed, up to 48 inches in Diameter or with Flat Surfaces up to 72 inches:
   1. Self-Adhesive Outdoor Jacket: 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross laminated polyethylene film covered with white aluminum-foil facing or 5 ply, non asphaltic, laminated aluminum and polyester film with pressure sensitive adhesive.

E. Piping, Exposed:
   1. PVC: 30 mils thick.
   2. Aluminum, Stucco Embossed: 0.016 inch thick.
   3. Self-Adhesive Outdoor Jacket: 60 mil thick.

END OF SECTION 23 07 00

SECTION 23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specifications Sections, apply to this section.

B. Refer to Construction Documents.

1.2 SUMMARY

A. The temperature control contractor shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems as herein specified. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation or identification number, and sequence of operation all bearing the name of the manufacturer. The installing manufacturer shall certify, in writing, that the shop drawings have been prepared by the equipment manufacturer and that the equipment manufacturer shall certify, in writing, that the shop drawings were prepared by their company and that all temperature control equipment was installed under their direct supervision.

B. All materials and equipment used shall be standard components, regularly manufactured for the specified system. All systems and components shall have been thoroughly tested and proven in actual use of at least 2 years.

C. Temperature control contractor shall be responsible for:
1. Providing of a complete DDC electronic automatic temperature control system.
2. Control of heating water system, air handling units, VAV terminals, cabinet heaters, propeller unit heaters and exhaust fans, as denoted on drawings, etc. in accordance with requirements herein specified.
3. Providing of control devices, valves, instruments, and the like, as herein specified and as required to comply with required sequences of automatic control.
4. Providing of wiring for secondary control devices, relay switches, safety low limit controls, etc., and such interlock wiring required.
5. Furnishing adequate supervision on Work performed for him by others to insure proper operation and the neatest and best possible arrangement.
6. Testing, maintenance of system as herein specified.
7. Providing all necessary transformers for low voltage control wiring requirements. The Contractor is required to provide all necessary control panels and 120V power to those panels for a complete system. All 120V wiring shall meet the requirements of the electrical specifications.
8. Integration with variable frequency controllers, and other equipment and control devices specified in other sections of the specifications.
9. Providing all control wiring, conduit, junction boxes, etc. as required.
10. The drawings show locations of the existing control panels with 120 volt power wiring. If the temperature control system design prepared by the Contractor requires additional panels, all such additional panels shall be provided at no additional cost to the Owner and shall be installed only in locations approved by the Architect / Engineer. The Temperature Control Prime shall provide all additional 120 volt power required for operation of the temperature control system at no additional cost to the Owner. Connection locations for sources for any additional power circuits shall be submitted for approval. All additional 120 volt wiring shall meet the requirements of Division 26.
11. This contractor shall provide labeling to all control system sensors, panels, devices and actuators. The label names shall match the point names labeled in the control graphics and as-built drawings.

12. The Temperature Control Contractor is responsible to have a fully functioning temperature control system including remote access to the BAS by the date of Substantial Completion of the project.

D. The temperature control contractor shall read all other Drawings and Specifications, become familiar with requirements and scope of the Project, and include such coordination work as may be required.

E. HVAC Control System shall be installed and configured such that other fully trained and certified contractors are able to perform repair, replace, and upgrade individual hardware without further interaction with the installing contractor.

F. The installing contractor shall provide all necessary documentation, data, configuration information, configuration tools, programs, drivers, and other software such that other fully trained and certified contractors are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the installing contractor.

G. Associated Services: Cooperate with test and balance contractor performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the work.
2. Incidental labor and facilities necessary to facilitate tests, inspections, and recalibration.
3. Provide access password in controls system.

H. Temperature Control Contractor shall display all DDC points and setpoints on graphics and linked text screens and make all these points and set points adjustable with the ability to restrict any point and set point from being adjustable through multiple level/tiered password protection.

I. The equipment provided with factory mounted controllers and programmed by the unit manufacturer. The Temperature Control Contractor shall integrate with these controllers for seamless operation. Coordinate requirements with unit manufacturer

J. Related Sections include the following:
1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
2. Division 23 Section "Meters and Gauges for HVAC Piping" for measuring equipment that relates to this Section.
3. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. MS/TP: Master slave/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

1.4 SOFTWARE LICENSE AGREEMENT

A. Software and Firmware Operational Documentation: Include the following:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.
   5. Software license required by and installed for DDC workstations and control systems.

B. Software Upgrade Kit: Future graphical user interface software versions to be provided to the Owner for upgrades of the original installation if such updates include features that will benefit the end user.

C. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, and graphical software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the front end graphical user interface, and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner.
   1. Contractor shall provide the Owner with a Software Maintenance Plan (SMP) that provides for all software updates made available by the controls manufacturer for one (1) years from the date of Owner Acceptance.
   2. Contractor is responsible for installation of all upgrades through the end of the SMP and shall obtain the Owner's permission before installing any software updates.

1.5 SOFTWARE

A. The Contractor shall load all graphical user interface software required for an operational DDC system, including data bases (to include data bases for all points specified and shown), operational parameters, and system, command, and programs.

B. Software shall include all necessary software to allow for;
   1. Operational use of the system
   2. Owner to make programming changes or point additions
   3. Owner to implement manufacturer's Standard Graphics in the future
   4. Owner to modify, add or delete Custom Graphics in the future
   5. Troubleshooting

C. Within 30 days of the Owner obtaining the DDC network provided under this Contract, the Contractor shall provide original and backup copies of software, on each type of media utilized.

D. Upgrades: BAS contractor shall provide software/firmware updates for the system provided for the warranty period. Include a minimum 8 hours per year training on each software/firmware update.

1.6 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:
   1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
   2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
   3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.

4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
    a. Water Temperature: Plus or minus 1 deg F
    b. Water Flow: Plus or minus 5 percent of full scale.
    c. Water Pressure: Plus or minus 2 percent of full scale.
    d. Space Temperature: Plus or minus 1 deg F
    e. Ducted Air Temperature: Plus or minus 1 deg F
    f. Outside Air Temperature: Plus or minus 2 deg F
    g. Dew Point Temperature: Plus or minus 3 deg F
    h. Temperature Differential: Plus or minus 0.25 deg F
    i. Relative Humidity: Plus or minus 5 percent.
    j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
    k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
    l. Airflow (Terminal): Plus or minus 10 percent of full scale.
    m. Air Pressure (Space): Plus or minus 0.01-inch wg
    n. Air Pressure (Ducts): Plus or minus 0.1-inch wg
    o. Carbon Monoxide: Plus or minus 5 percent of reading.
    p. Carbon Dioxide: Plus or minus 50 ppm.
    q. Electrical: Plus or minus 5 percent of reading.

1.7 MANDATORY PRE-SUBMITTAL MEETING

A. The contractor shall convene a pre-submittal meeting with the engineer and Owner within one month of the notice to proceed. The purpose of this meeting is to review the sequences of operation, outline where the proposed system deviates from the specified sequence of operation, and identify potential problems with the specified sequence. Once the sequences of operation are agreed to by all parties, the contractor should proceed with the formal controls submittal process. The contractor shall submit a print out of all graphics proposed for the project within one month following the submittal approval.

1.8 SUBMITTALS

A. The BAS subcontractor shall submit the following information to the Engineer for review with their bid package;
    1. Manufacturer’s Product Data Sheets for major system components;
        a. Enterprise Server
        b. System Controller
        c. Advanced Application Controller
        d. Application Specific Controller

B. Control Diagrams
    1. Prior to installation and as required, submit to the Architect/Engineer a complete system diagram, showing control connections and devices and their connection to other equipment, together with a clearly written description of the system and an outline of its function under conditions of operation.
    2. Submittals shall be prepared on, or folded to, 8-1/2 inch by 11 inch size and bound in brochure form.
    3. DDC logic and control diagrams shall be included for all equipment and sequences of control.

4. Upon completion of the Work, provide the complete, accurate, and approved diagrammatic blueprinted layouts on the automatic control system specified herein and as installed. Layouts shall show all control equipment including job installation changes, and the function of each system shall be indicated. Layouts and descriptions shall be included in the project record set and in the operating and maintenance manuals.
5. Final points list to be provided prior to control programming.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including close-off and flow characteristics.
8. Schedule of air flow measuring equipment including size, velocities, and flow at minimum and maximum air flow.
9. Schedule of meters including size and flow range.

C. Equipment
   1. Submit shop drawings for the Architect/Engineer's approval on all, but not limited to, the following equipment and components indicating arrangements, capacities, range, voltage, horsepower, construction.
      a. Valves
      b. Thermostats
      c. Relays
      d. Panels
      e. Gauges
      f. Sensors
      g. Dampers
      h. Switches
      i. Pressure Controllers
      j. DDC microprocessor
      k. Unitary DDC controllers
      l. Actuators

D. Project Record Documents: The Temperature Control Contractor shall provide the Owner with a complete set of all final documentation including final sequence of operations and system diagrams.

E. Controls Graphics
   1. Equipment Graphics must have written approval from A/E. The Contractor is responsible to initiate a meeting with A/E, and Owner’s Representative. A minimum of 10 days notice must be given prior to meeting. Items to be addressed include:
      a. All major equipment and components controls graphics both web server and unit controllers.
      b. Labels of all units, panels, actuators, and sensors to match the as-built drawings.
      c. Set-points, alarms, and sensors to match as-built drawings.
      d. Adjustable and non-adjustable set-points display.
   2. The Contractor shall submit print-out of proposed graphics for each sample piece of equipment for approval. Graphics to be submitted within one month following shop drawing submittal approval.
   3. All Graphics shall reside in and be served up by the web server. In addition to the web server, all building controllers shall have graphic’s included in them and shall be able to serve the graphics for the equipment they control over on/or through the school’s Ethernet network without the web server, should the server become unavailable.

F. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

G. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Schedule of valves including flow characteristics.
6. DDC System Hardware:
    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
7. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
8. Controlled Systems:
    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

H. Provide a BACnet Protocol Implementation Conformance Statement (PICS) for each BACnet system level device (i.e. Building Controller & Operator Workstations) type. This defines the points list for proper coordination of interoperability with other building systems if applicable for this project.

1.9 PROJECT RECORD DOCUMENTS

A. Submit three copies of record (as-built) documents upon completion of installation for approval prior to final completion. Each building shall be submitted independently. Submittal shall consist of:

1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2020 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and 6 prints of each drawing on 11" x 17" paper.
2. Operation and Maintenance (O&M) Manual. Printed, electronic, and online help documentation of the following:
    a. As-built versions of submittal product data.
    b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.

c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.

d. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.

e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.

f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.

g. Graphic files, programs, and database on magnetic or optical media.

h. List of recommended spare parts with part numbers and suppliers.

i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.

j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.

k. Licenses, guarantees, and warranty documents for equipment and systems.

l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

m. All adjustable setpoint ranges shall be included in the as-built sequences. For systems that do not have this feature, all sensor inputs shall be required to be brought into a virtual point so that virtual points can be manipulated for system testing.

1.10 QUALITY ASSURANCE

A. Electrical components shall be UL listed.

B. Damper components shall comply with AMCA 500.

C. Energy management components shall comply with NEMA EMCI.

D. Enclosures shall comply with NEMA 250.

E. Electrical requirements shall meet NFPA 70.

F. Installation as a part of the HVAC system shall comply with NFPA 90A.

G. Central system shall meet the requirements of ASHRAE Standard 90.1.

1.11 CONTRACTOR RESPONSIBILITIES

A. The contractor shall be responsible for final design drawings, installation of all control wiring and control devices in accordance with National Electric Code. The temperature control contractor shall also be responsible for startup and complete checkout of the systems.

B. This Contractor shall furnish complete drawings, component lists, specification sheets and sequences of operation to the Engineer for approval before start of installation.

C. After corrections and any job installation changes, 3 sets of full drawings, parts lists, specification sheets, and operation and maintenance manuals are to be furnished to the Owner.

D. All DDC logic diagrams shall be updated as built and included in the Operation and Maintenance Manuals for the Owner.

E. The contractor is responsible to use all room numbers developed and approved by the University in the development of the temperature control system for this building.

F. This Contractor shall assist the Test and Balance Procedures as required to complete his work.

G. The Contractor shall turn over a printed copy and electronic copy of the completed and debugged operating software to the Owner at the conclusion of the first year warranty. Turnover shall include all passwords, logic, any other system keys, programming tools, and any other locks in system to allow modification by Owner.

H. The Contractor is responsible to label all temperature control system sensors, control panels, control dampers and operators, and control valves and operators. Label names shall match the point names of the control system and on the as-built drawings.

I. The Contractor shall provide the Owner with all necessary software and licenses so the Owner has the ability to change all set points, schedules, and programs for the life of the system even if it is a completely independent piece of software.

J. Contractor shall be responsible for the accurate location of their Work and for informing themselves of the nature and arrangement of the materials, equipment, and construction to which their Work attaches or passes through.

K. In general, work shall be concealed in walls in conduit and above ceilings in wire management systems, conduit in chases, and in equipment rooms, insofar as is practical; so that such work will not interfere with the proper coordinated installation work of other trades or Contractors.

L. In general, wiring, and conduit shall be installed parallel (or at right angles) to the building walls, and at such heights as not to obstruct any portion of windows, doorways, stairways, pipe space, tunnels, or passageways, and properly concealed to not interfere with the proper coordinated installation of other trades or Contractors. Where interferences develop in the field, the Work shall be offset or routed as required to clear such interferences. Consult all bid documents and coordinate with other Contractors before installing work.

1.12 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. The following items shall be furnished to the Mechanical Contractor for installation in the mechanical rooms where new heating and chilled water systems and equipment are being installed.

B. Heating and cooling piping:
   1. Control valves
   2. Flowmeters
   3. Pressure and temperature sensor wells and sockets
   4. Coordinate locations with all Contractors
   5. Other items as noted on the drawings.

C. Duct accessories:
   1. Automated dampers, unless noted otherwise.
   2. Other items as noted on the drawings

D. In all other areas of the buildings, the Temperature Control Contractor shall furnish and install all required equipment and components as required to comply with the sequence of operations. This requirement includes the furnishing and installation of new temperature control valves as indicated on the drawings, schedules and/or sequences of operation. Installation shall include re-insulating to match existing.

1.13 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

A. Communications with Third Party Equipment:
   1. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet interlace for integration into the Direct Digital Control System described in this section.

B. Smoke detector supplied by electrical contractor and installed by others. Detector shall include dry contact for building automation system.

C. Refer to project manual Division 23 specifications for equipment interface/integration requirements

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The temperature control system specification is based on products manufactured by one of the following manufacturers. All approved systems must integrate to an acceptable open protocol, web browser system. The system shall be designed, manufactured, engineered, and demonstrated by employees in the direct employment of the manufacturer. Electrical wiring may be subcontracted to a licensed electrical contractor with low voltage controls experience. Installation of new control valves may be subcontracted to a licensed mechanical contractor with relevant experience. The Controls Contractor shall provide adequate supervision and quality control for each installing subcontractor.
   1. Johnson Controls, Inc.; Metasys BMS, N2.
   2. Schneider Electric; Modicon, Modbus RTU.
   3. Automated Logic; WebCTRL
   4. Honeywell WEBS
   5. Reliable Controls

B. The temperature control contractor shall have 10 years experience in the installation of the same size and type of control system as proposed.

C. The temperature control system shall be bid and installed by an authorized branch office of the manufacturer.

2.2 DAMPERS

A. Dampers intended for automatic control, unless part of a factory made unit, shall be furnished by the temperature control contractor. Automatic dampers installed in unitary equipment furnished by the manufacturer shall be checked for proper size and design by the Temperature Control Contractor. Should any features of these dampers appear to be unsatisfactory, full details shall be given to the Engineer, in writing, and suggestions made for necessary corrections.

B. Return Air Dampers
   1. Return air dampers, unless otherwise specified, shall be "low leakage" dampers, and shall be designed for tight shut-off such that for a 1500 FPM damper, leakage does not exceed 1.7 CFM at 1 inch W.G. differential static pressure.
   2. Damper frame shall be 4” deep constructed of extruded aluminum (6063T5) not less than .080 (2.03mm) inches thick.
   3. Damper Blades shall be constructed of extruded aluminum (6063T5) and airfoil design. Aluminum end caps shall be press fitted to the blade ends.
   4. Silent closing replaceable silicone seals shall be provided on each blade and on all four sides of the frame. Louver linkage to be concealed in frame channel outside of the air stream. Bearings shall be constructed of a celcon inner bearing fixed to a 7/16” aluminum hexagon type blade pin rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal to metal contact or metal to plastic contact.
   5. Blade and frame seals shall be secured in an integral slot within the aluminum extrusions.
   6. Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.
   7. Modulating dampers shall be opposed blade type.
   8. Whenever practicable, damper size shall be based on 1000 to 1500 FPM air velocity.
   9. Dampers shall be designed to operate in temperature ranges from –40 degrees F and 212 degrees F.
   10. Acceptable manufacturers: Tamco Model 1500 or approved equal

C. Outside Air and Relief Air Dampers
   1. Automatic dampers used for outside air and relief air applications shall have similar type of construction as described above for return air dampers, but shall include extruded aluminum blade shell internally insulated with expanded polyurethane foam and thermally broken.
   2. Damper frame shall be extruded aluminum, minimum 4” deep and insulated with Styrofoam on all four sides of the damper.
   3. Blade and frame seals shall be extruded silicone and secured in an integral slot within the aluminum extrusions.
   4. Dampers shall not exceed 4 cfm per sq. ft. against 4” w.g. and shall be AMCA Rated.
   5. Standard control dampers are not acceptable in outside air and relief air applications to avoid possible freeze conditions.
   6. Acceptable manufacturers: Tamco Model 9000 SC or approved equal.

2.3 VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

B. Globe Valves NPS 2” and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure. Valves shall have allowable media temperature of 20°F to 281°F to assure that the valve packing will have a long life (valves will narrower allowable media temperatures have no reserve packing capability for long term watertight seal).

C. Globe Valves NPS 2-1/2” and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.

D. Hydronic system globe valves shall have the following characteristics:
   1. Rating: Class 125 for service at 125 psig and 250°F operating conditions.
   2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
      a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
      b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
   3. Sizing: 3 psig. maximum pressure drop at design flow rate.

4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.

E. Butterfly Valves: 200 psig. maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Wafer, Lug, or Grooved.
2. Disc Type: Nickel-plated ductile iron, Aluminum bronze, Elastomer-coated ductile iron, Epoxy-coated ductile iron.
3. Sizing: 1 psig maximum pressure drop at design flow rate.

F. Terminal Unit Control Valves: Bronze body, bronze trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250ºF operating conditions.
2. Sizing: 3 psig maximum pressure drop at design flow rate, to close against pump shutoff head.

G. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

H. Sizing of Valves: Valves shall be furnished to the HVAC Contractor who will mount them as piping is installed. Valve sizes shall be as recommended by the temperature control manufacturer who shall be responsible for their proper sizing, regardless of indicated valve or line size on Drawings. Water valves shall not exceed 5 psi pressure drop, unless otherwise stipulated.

2.4 VALVE AND DAMPER OPERATORS

A. Damper Operators
1. Damper operators shall be electronic, spring return, low voltage (24VAC), and shall be properly sized so as to stroke the damper smoothly and efficiently throughout its range.
Actuator response shall be linear in response to sensed load.
a. Damper operators on outside air intakes shall be spring return closed.
b. Damper operators on return dampers shall be spring return open.
c. Damper operators on pressure dampers shall be spring return closed.
d. All non-spring return damper must have manual override ability built into the actuator.
2. Operators shall have ample power to overcome damper linkage friction and 200 percent of the torque required. Provide not less than one damper operator for each 25 square feet of damper area.
3. All damper operators shall be warranted for 5 years from date of manufacturing.

B. Valve Operators
1. Valve actuators shall be electronic or floating type, low voltage (24VAC), and properly selected for the valve body, service, and DDC control functions.
2. Actuators shall be fully proportioning and be spring return for normally open or normally closed operation as called out in the sequence of operations.
a. Heating valves on units that have outdoor air connections shall be spring return open.
b. Heating valves on units that do not have outdoor air connections do not require spring return.
c. All non-spring valves must have manual override ability built into the actuator.
3. All valve operators shall be warranted for 5 years from date of manufacturing.

4. All non-spring return valves must have manual override ability built into the actuator.
5. Valve actuators serving unitary and terminal devices such as VAV boxes may be incremental or triac (pulse modulated) electric actuators without spring return.

2.5 RELAYS

A. Electric
1. Where required, provide relays for energizing or re-energizing the various branch circuits, in response to master control panels. Relays shall be UL labeled and sized for not less than 140 percent of the connected amperage load. Relays shall be rated for the system voltage and have proper throw and poles.

2.6 SENSING DEVICES

A. Under Alternate bid (refer to list of alternates), the Controls Contractor shall replace all existing room sensors (temperature, pressure, humidity, CO2, etc.) with new. The Controls Contractor, may, at the sole risk of the contractor, re-use existing temperature, pressure or flow sensors currently in use on Air Handling Units and hydronic systems. The Controls Contractor is solely responsible for ensuring the integrity of re-used sensors and shall warrant them “as new” according to the warranty requirements specified.

B. Electronic Temperature Sensors
1. Provide temperature sensors and other temperature indicating sensors of commercial grade quality located at the point of measurement and installed according to the manufacturer's recommendations.
2. Thermistor temperature sensors shall be 10,000 ohm at 77 F with Precon type-3 material. Accuracy shall be +/-0.36 F between the range of 32.0 - 158.0 F.
3. Provide temperature sensors such that the BAS shall be able to convert the resistive input signal available from the element into a digital signal for use by the BAS.
4. Provide outside air temperature sensors with a watertight fitting and adequate protection from the effects of solar radiation.
5. Provide water temperature sensors of the bulb type, mounted within brass or stainless steel wells filled with a heat conductive compound and in direct contact with the water within the pipe.
6. All field mounted sensors shall be labeled as to their function and name used in the control program.

C. Electronic Room Temperature Sensors
1. Temperature sensors shall be Precon type-3 or equal thermistors utilizing a 10K ohm thermistor. Sensors shall be manufactured in a durable epoxy housing and shall be enclosed for protection from elements when installed in the sensors operating environment. The sensor cover shall be provided with tamperproof screws.
2. The range of set point adjustment shall be initially programmed for +/- 3 °F.
3. Provide LCD temperature display

D. Electric Thermostats
1. Electric thermostats shall be line voltage type of single-pole, single-throw design.
2. Sensing element shall be liquid-filled.
3. Thermostat shall include an accessible adjustment knob for setting temperature setpoints.
4. Covers and base plates shall be of standard design and finish.

E. Electronic Duct Temperature Sensors
1. All duct sensors shall be true averaging type sensors with capillary lengths not less than 20 feet long. The only exceptions will be return air and outdoor air sensors.
2. All duct sensors shall be installed within enclosures that are suitable for the application.

F. Sensor Guards
   1. Provide guard of almond colored, mounted with back frame to wall and tamperproof screws where denoted on drawings with a sub "G".
   2. Guards shall be equal to Uni-Gard, Inc., Model UG-2A.

G. Safety Low Limit Thermostats
   1. Safety low limit thermostats with flexible sensing elements shall serpentine full length of duct or coil. Instrument to be sensitive to lowest temperature at any 12 inch increment on its 20 foot length. Thermostat shall have a range of 34 degrees F. to 60 degrees F. with a fixed 5 degrees F. differential.
      a. Safety low limit thermostats shall be capable of being reset through software at the building energy management computer.

H. Electronic Pressure Sensors
   1. Provide pressure sensors and other pressure indicating sensors of commercial grade quality located at the point of measurement and installed according to the manufacturer's recommendations.
   2. Provide pressure sensors of the direct acting or reverse acting, unidirectional or bi-directional type such that the BAS shall be able to convert the 0 to 5 volts DC input signal available from the sensor into a digital signal for use by the BAS.
   3. Provide pressure sensors utilizing the smallest possible operating range which will sufficiently cover the range required for normal operating conditions.
   4. Provide pressure sensors of the ultra precision type with a tolerance at 70 degrees F of no greater than plus/minus .8 percent of full scale and an end-to-end (full scale) accuracy of plus/minus 2 percent of full scale.
   5. Building Static-Pressure Range: -.1 to .1, -0.25 to 0.25, -.5 to .5, -1.0 to 1.0 IN WC., jumper selectable.
   6. Duct Static-Pressure Range: 0 to 1, 0 to 2.5, 0 to 5, 0 to 10 IN WC., jumper adjustable.
   7. All field mounted sensors shall be labeled as to their function and name used in the Building Automation System software program. When a pressure sensor reaches its maximum range, the BAS shall generate an alarm. The alarm set point shall be user adjustable in case jumper position is changed.

I. Humidity Sensors
   1. Shall be a "Current Type" humidity transducer. Sensor shall produce a linear 4-20mA current representing the span of the sensor. This signal shall be produced by the sensor itself through a current convertor supplied with the sensor.
   2. Outdoor air humidity sensor shall be enclosed in a weathertight enclosure and shall be located in a place to provide best representation of outdoor air relative humidity. Sensor span shall be 10 to 90 percent relative humidity and shall be accurate within $\pm$ 2 percent of span.
   3. Space humidity sensor shall be enclosed in a durable enclosure for mounting in interior zones. Sensor shall have a range of 0 to 100 percent relative humidity and shall be accurate with $\pm$ 2 percent of span.
   4. Duct humidity sensor shall be a probe type with all wiring enclosed in an electrical box. Sensor shall have a range of 0 to 100 percent with an accuracy of $\pm$ 3 percent of span.
   5. Provide one exterior humidity sensor.
   6. Provide four zone humidity sensors inside the building envelope. Locate below ceiling at locations indicated on the temperature control drawings.

J. Current Sensing Status Switch
   1. Shall be capable of detecting changes in flow of current to motors in determining accurate and reliable equipment status.
   2. Ampere rating for 0 - 135 amps continuous.
   3. Sensor supply voltage shall be included from monitor conductor.
   4. Minimum current required is 1 amp.
   5. Trip setpoint shall be adjustable to +/- 1 percent of range.

K. Remote Differential Pressure Transmitter (DPT)

1. Differential Pressure Transmitters shall be provided by the Temperature Control Contractor to be completely self-contained, variable capacitance type gauge pressure transmitters. Wiring terminals and electronics shall be in separate compartments, so the electronics remain sealed during installation. Reverse polarity protection shall be included to keep wiring mishaps from damaging the transmitter. The 4-20mA DC signal shall be transmitted over a pair of No. 22 gauge or larger wire directly to the control enclosure.
2. Design range shall be as required by system. External zero and span adjustments, over pressure to 2,000 PSI and no humidity effects.
3. Minimum accuracy shall be +/-0.25 percent of calibrated span. Includes combined effects of linearity, hysteresis and repeatability. Stability shall be +/-0.25 percent of upper range limit for 6 months. No internal mechanical linkages shall be used in the transmitter.

L. Flow Transducers (FT)

1. Flow meters with transducers shall be installed where indicated on the Drawings and wired by the Temperature Control Contractor.
2. The flow transducers shall utilize a nonmagnetic sensing mechanism with a forward-swept rotating impeller to produce a frequency signal proportional to flow. The flow transducers shall have an achievable accuracy of +/-1 percent of flow rate with flow velocities of 1 to 30 fps.
3. The flow meter shall be constructed of brass with a glass reinforced impeller, tungsten carbide shaft and glass reinforced polyphenylene sulfide housing. The unit shall be both insertable and removable through a gate type valve when the pipe is under pressure.
4. Provide minimum of 10 straight pipe diameters upstream and 5 diameters downstream for each field installed flow transducer.
5. Provide an insertion/extraction tool to allow removal and replacement of flow transducer while the system is under pressure.
    1. Sensor shall employ non-dispersive infrared technology repeatable to.
        b. Field selectable outputs of 0-10V or 4-20mA.
        c. LCD display of Co_2 ppm.

M. Duct Mounted Carbon Dioxide Sensors

1. Provide sensors in return air ducts to air handling units.
2. Sensor shall employ non-dispersive infrared technology repeatable to $\pm$ 20 ppm $\pm$ 1 percent of measured valve and accuracy to $\pm$ 30 ppm $\pm$ 5 percent or measured valve. a. Measurement range: 0-2000 ppm.
    a. Field selectable outputs of 0-10V or 4-20mA.
    b. LCD display of Co2 ppm.
    c. 5 year calibration intervals.

2.7 VARIABLE FREQUENCY DRIVES

A. Refer to Project Manual Section 262923 – Variable Frequency Motor Controllers.

B. Provide direct communication between the DDC/BAS system and the variable frequency drives (VFD). VFD fan/pump control data as well as drive power data (minimum voltage, current, and frequency) shall be available for data collection and trending at the DDC/BAS operator's workstation.

2.8 CONTROL CABINETS/ENCLOSURES

A. Control cabinet/enclosure shall be extruded aluminum, galvanized steel or factory-hardened plastic with key locks and hinged doors. Electric panels shall be of code steel construction with UL label.

1. The control cabinet/enclosure shall be required to house devices not enclosed as a part of the DDC building automation system panels. Pre-wire with internal wiring terminated at labeled terminal strips. Thermometers and switches shall be mounted on the cover of the panel. Relays, transformers, and components shall be mounted inside the panel. Devices, whether interior or exterior, shall be provided with legend plates of engraved formica or equal. Cabinets shall be located as approved by the Architect/Engineer or as indicated on the Drawings.
2. Where two or more control items or accessories (thermostats, thermometer, relay, etc.) are to be mounted at a single location, such equipment shall be mounted in a suitable cabinet. Cabinets shall be located as approved by the Architect/Engineer or indicated on the Drawings.
3. Local type panels need not contain graphic representations or symbols, unless specified below, but must contain approved nameplates, legends, etc., for each device.
4. Where panels contain any wiring, panels shall be UL approved cubicles.

2.9 BUILDING AUTOMATION SYSTEM

A. General
1. The Building Automation System (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, portable operator terminals, printers, network devices and other devices as specified herein. The installed system shall provide secure password access to all features, functions and data contained in the overall BAS.
2. The system shall be accessible through school's Ethernet system. The network shall be the responsibility of the controls manufacturer/contractor

B. Open, Interoperable, Integrated Architectures
1. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet technology communication protocols in one open, interoperable system.
2. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-1995, BACnet to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet.
3. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
4. The supplied system must incorporate the ability to access all data using standard WEB enabled browsers without requiring Java or proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.
5. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
    a. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
    b. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

6. All components and controllers supplied under this contract shall be true “peer-to-peer” communicating devices. Components or controllers “polling” by a host to pass data shall not be acceptable

C. Networks
1. The Local Area Network (LAN) shall be either a 10 or 100 Megabits/sec Ethernet network supporting BACnet, HTML5, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple System/Building Controllers (B-BCs), user workstations and, if specified, a local host computer system.
2. Local area network minimum physical and media access requirements:
   a. Ethernet; IEEE standard 802.3
   b. Cable; 10 Base-T, UTP-8 wire, category 5
   c. Minimum throughput; 10 Mbps, with ability to increase to 100 Mbps

D. Network Access
1. Remote Access
   a. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer’s Intranet to a corporate server providing access to an Internet Service Provider (ISP). Owner agrees to pay monthly access charges for connection and ISP.
   b. Where no Local Area Network exists, BAS supplier shall provide the following:
      1) 8 Port Ethernet hub (3Com, or equal)
      2) Ethernet router (Cisco or equal)
2. The owner shall provide a connection to the Internet to enable this access via highspeed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line or T1 Line. Owner agrees to pay monthly access charges for connection and ISP.

E. System/Building Controller (B-BC)
1. The System/Building Controller (B-BC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the (B-BC). It shall be capable of executing application control programs to provide:
   a. Calendar functions
   b. Scheduling
   c. Trending
   d. Alarm monitoring and routing
   e. Time synchronization
   f. Integration of BACnet controller data
2. The System/Building Controller must provide the following hardware features as a minimum:
   a. One Ethernet Port -10 / 100 Mbps
   b. One RS-232 port
   c. One BACnet Interface Port – 78KB FTT-10A
   d. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
   e. The (B-BC) must be capable of operation over a temperature range of 0 to 55°C
   f. The (B-BC) must be capable of withstanding storage temperatures of between 0 and 70°C
   g. The (B-BC) must be capable of operation over a humidity range of 5 to 95% RH, non-condensing
3. The (B-BC) shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

4. The Building Controller shall serve as a Web Server with a unique URL that will allow remote access directly to the BAS system using only a web browser, such as Internet Explorer. Access to the internet at the building shall be provided. The use of third party servers, VPNs, etc. are not acceptable.
    a. The Web pages shall be similar to the work-station interface with full color graphics incorporating dynamic points including temperatures, valves positions, etc. and ability to change setpoints, access alarms and change the Time-of-Day Schedules.
    b. Web pages shall be available for users to view the general building plan with current operating parameters and conditions in each space and with links to pages for various equipment items and systems serving those spaces.
    c. Web pages shall be available for users to view each mechanical system and sub-system including each air handler, chiller, boiler, pumping system, etc. with links to detailed screens for related equipment and links to text screens of control sequences for the equipment shown
    d. The graphics for each system shall represent in a general way the arrangement of major pieces of equipment within each space (i.e. location of boilers, pumps, etc.).
    e. Animation shall be used to visually indicate run status of each component (i.e. spinning fans, pumps, valves open/closed, etc.), and include real-time conditions at each component.
    f. Web Server shall not require the use of any software add-ins such as Java ™ for operation. Use os such add-ins is prohibited.
5. Event Alarm Notification and actions
    a. The (B-BC) shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
    b. The (B-BC) shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
    c. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
        1) To alarm
        2) Return to normal
        3) To fault
    d. Provide for the creation of an unlimited number of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
    e. Provide timed (schedule) routing of alarms by class, object, group, or node.
    f. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
6. Control equipment and network failures shall be treated as alarms and annunciated.
7. Alarms shall be annunciated in any of the following manners as defined by the user:
    a. Screen message text
    b. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
        1) Day of week
        2) Time of day
        3) Recipient
    c. Pagers via paging services that initiate a page on receipt of email message.
    d. Building graphical display with flashing alarm objects/areas.
    e. Printed message, routed directly to a dedicated alarm printer.
8. The following shall be recorded by the (B-BC) for each alarm (at a minimum):
    a. Time and date
    b. Location (building, floor, zone, office number, etc.)
    c. Equipment (air handler #, accessway, etc.)

d. Acknowledge time, date, and user who issued acknowledgement.
e. Number of occurrences since last acknowledgement.

9. Alarm actions may be initiated by user defined programmable objects created for that purpose.
10. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
11. A log of all alarms shall be maintained by the (B-BC) and/or a server (if configured in the system) and shall be available for review by the user.
12. Provide a “query” feature to allow review of specific alarms by user defined parameters.
13. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
14. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

F. Data Collection and Storage

1. The (B-Bc) Shall have the ability to collect data for any property of any object and store the data for future use.
2. The data collection shall be performed by log objects, resident in the (B-BC) that shall have, at a minimum, the following configurable properties:
    a. Designating the log as interval or deviation.
    b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
    c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
    d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
    e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action
3. All log data shall be stored in a relational database in the (B-BC) and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements
5. All log data shall be available to the user in the following data formats:
    a. HTML
    b. XML
    c. Plain Text
    d. Comma or tab separated values
    e. MS Excel
    f. Adobe PDF
6. The (B-BC) shall have the ability to archive it’s log data either locally (to itself), or remotely to a server or other (B-BC) on the network. Provide the ability to configure the following archiving properties, at a minimum: a. Archive on time of day
    a. Archive on user-defined number of data stores in the log (buffer size)
    b. Archive when log has reached it’s user-defined capacity of data stores
    c. Provide ability to clear logs once archived
7. At a minimum, a trend log shall be established for the following and for any other owner deemed points:
    a. Hot water supply temperature
    b. Hot water return temperature.
    c. Air handling unit variable frequency controller (VFC) output.
    d. Heating water system differential pressure.
    e. CO2 level inputs.
    f. Humidity Levels.
    g. Refer to drawings and sequence of operations for additional requirements

G. Audit Log
1. Provide and maintain an Audit Log that tracks all activities performed on the (B-BC). Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it's user-defined buffer size. Provide the ability to archive the log locally (to the (B-BC)), to another (B-BC) on the network, or to a server. For each log entry, provide the following data.
    a. Time and date
    b. User ID
    c. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

H. Database Backup and Storage
1. The (B-BC) shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
2. Copies of the current database and, at the most recently saved database shall be stored in the (B-BC). The age of the most recently saved database is dependent on the userdefined database save interval.
3. The (B-BC) database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported

I. Advanced Application Controls (B-AAC)
1. Advance Application Controllers shall be used to control all equipment or applications of medium and high complexity, including but not limited to Air Handlers, Boiler Plants and Chiller Plants.
2. For Stand-Alone Operation of Advanced Application Controllers:
    a. Shall operate a schedule in a standalone application using a Real Time Clock with a 7 day power backup.
    b. The Controller shall have a built in schedule (assessable with or without a display).
    c. Support will be for at least 3 schedules with up to 10 events for each day of the week.
    d. Each of the 3 schedules can be Analog, Binary or Multi-State.
    e. The controller shall support a minimum of 25 exceptions each with up to 10 events
3. For ease of troubleshooting, the Controller shall support data trend logging.
    a. 25,000 samples minimum.
    b. Trends shall be capable of being collected at a minimum sample rate of once every second.
    c. Trends shall be capable of being scheduled or triggered.
4. Controller shall be capable of supporting color graphic local user display and interface panel with 7" diagonal screen.
5. To meet the sequence of operation for each application, the Controller shall use library programs provided by the controller manufacturer that are either factory loaded or downloaded with service tool to the Controller.
6. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
7. Storage conditions:
    a. Temperature: -67°F to 203°F (-55°C to 95°C).
    b. Humidity: Between 5% to 100% RH (non-condensing).
8. Operating Conditions:
    a. Temperature: -40°F to 158°F (-40°C to 70°C).
    b. Humidity: Between 5% to 100% RH (non-condensing).
9. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
10. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° F to 158° F [-40° C to 70° C].
11. Input/Output: The Controller shall have on board or through expansion module all I/O capable of performing all functionality needed for the application. Controls provided by the equipment manufacture must supply the required I/O for the equipment. In addition other controls must meet the following requirements:

a. Shall support flexibility in valve type, the controllers shall be capable of supporting the following valve control types: 0-10VDC, 0-5VDC, 4-20mA, 24VAC - 2 position.
b. Shall support flexibility in sensor type, the Controller shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, 50ms or longer pulses, 200 to 20Kohm and RTD input.
c. Shall support flexibility in sensor type, all Analog Outputs shall have the additional capability of being programmed to operate as Universal Inputs or Pulse Width Modulation Outputs.
d. Shall support flexibility in sensor type, the Controller and/or expansion modules shall support dry and wetted (24VAC) binary inputs.
e. The controller shall support pulse accumulator for connecting devices like energy meters.
f. In order to support a wide range of devices, the Controller's binary output shall be able to drive at least 10VA each.
g. Any unused I/O that is not needed for the functionality of the equipment shall be available to be used by custom programs on the Controller and by any other controller on the network.
h. The Controller shall provide 24VAC and 24VDC power terminals sensors and other devices required.
i. The Controller shall provide a dedicated static pressure input

12. Input/Output Expandability – The Controller shall provide the following functionality in order to meet current and future application needs:
    a. For the application flexibility, the Controller shall be capable of expanding to a total of at least 100 hardware I/O terminations.
    b. Expansion I/O can be mounted up to 650 ft. (200m) from control.
    c. Expansion I/O can be added in as small as 4 point increments.
    d. To keep BACnet MS/TP network traffic to a minimum, expansion I/O must communicate via an internal controller communication bus (point expansion via the BACnet MS/TP network is not allowed).
13. Serviceability – The Controller shall provide the following in order to improve serviceability of the Controller:
    a. Diagnostic LEDs for power/normal operation/status, BACnet communications, sensor bus communications, and binary outputs. All wiring connections shall be clearly labeled and made to be field removable.
    b. Binary and analog inputs and outputs shall use removable connectors or be connected to terminal strip external to the control box.
    c. Software service tool connection through all of the following methods: direct cable connection to the Controller, connection through another controller on BACnet link and through the Controller's zone sensor.
    d. For safety purposes, the controller shall be capable of being powered by a portable computer's USB port for the purposes of configuration, programming and testing programs so that this work can be accomplished with the power off to the associated equipment.
    e. The Controller software tool service port shall utilize standard off-the-shelf USB printer cable.
    f. Capabilities to temporarily override the BACnet point values with built-in time expiration in the Controller.
    g. To aid in service replacement, the Controller shall easily attached to standard DIN rail mounting.
    h. For future expansion, the Controller shall be capable of adding sequence of operation programming utilizing service tools software with a graphical programming interface (editing or programming in line code is not permissible).
    i. To aid in service replacement, the Controller shall allow for setting its BACnet address via controller mounted rotary switches that correspond to the numerical value of the address. (DIP switch methodologies are not allowed). Setting of the address shall be accomplished without the need of a service tool or power applied to the controller
14. Controller data shall be maintained through a power failure.

15. Software Retention: All Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.
16. Transformer for the Controller must be rated at minimum of 115% of ASC power consumption, and shall be fused or current limiting type. 24 VAC, +/- 15% nominal, 50-60 Hz, 24 VA plus binary output loads for a maximum of 12 VA for each binary output.
17. Controller must meet the following Agency Compliance:
    a. UL916 PAZX, Open Energy Management Equipment.
    b. UL94-5V, Flammability.
    c. FCC Part 15, Subpart B, Class B Limit.
    d. BACnet Testing Laboratory (BTL) Listed

J. Application Specific Controllers (B-ASC)
1. Application Specific Controllers (ASC) shall be microprocessor-based DDC controllers which, through hardware or firmware design, control specified equipment. They are not intended to be capable of fully custom user programming, but are customized for operation within the confines of the equipment they are designed to serve.
    a. Application Specific Controllers are only allowed when both the following are met:
        1) The equipment is compressor based or boiler based.
        2) The controller is provided by the equipment manufacturer and warrantied as part of the equipment.
2. Zone Controllers are ASC controllers that operate equipment that control the space temperature of single zone. Examples are controllers for VAV, Fan coil, Blower Coils, Unit Ventilators, Heat Pumps, and Water Source Heat Pumps.
3. Software
    a. To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.
    b. Stand-Alone Operation: Each piece of equipment specified in section “A” shall be controlled by a single controller and provide stand-alone control in the event of communication failure. In case of communications failure stand-alone operation shall use default values or last values for remote sensors read over the network such as outdoor air temperature.
    c. For controlling ancillary devices and for flexibility to change the sequence of operation in the future, the controller shall be capable running custom programs written in a graphical programming language.
4. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.
    a. Storage: -55° to 203° F (-48° to 95° C) and 5 to 95% Rh, non-condensing.
    b. Operating: -40° to 158° F (-40 to 70° C) and 5 to 95% Rh, non-condensing.
    c. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
    d. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° to 158° F [-40° to 70° C
5. Input/Output
    a. For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC floating point, 24VAC - 2 position (Normally Open or Normally Closed).
    b. For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, pulse counts, and 200 to 20Kohm.
    c. For flexibility in selection and replacement of binary devices, the controller shall support dry and wetted (24VAC) binary inputs.
    d. For flexibility in selection and replacement devices, the controller’s shall have binary output which are able to drive at least 12VA each.
    e. For flexibility in selection and replacement of motors, the controller shall be capable of outputting 24VAC (binary output), DC voltage (0 to 10VDC minimum range) and PWM (in the 80 to 100 Hz range).

f. For future needs, any I/O that is unused by functionality of equipment control shall be available to be used by custom program on the controller and by another controller on the network.
g. For future expansion and flexibility, the controller shall have either on board or through expansion, 20 hardware input/output points. Expansion points must communicate with the controller via an internal communications bus. Expansion points must be capable of being mounted up to 650ft. (200 m) from the controller. Expansion points that require the BACnet network for communication with the controller are not allowed.

6. Serviceability – The controller shall provide the following in order to improve serviceability of the controller.
   a. Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.
   b. All binary output shall have LED's indicating the output state.
   c. All wiring connectors shall removable without the use of a tool.
   d. Software service tool connection through all of the following methods: direct cable connection to the controller, connection through another controller on BACnet link and through the controller's zone sensor.
   e. For safety purposes, the controller shall be capable of being powered by a portable computer for the purposes of configuration, programming, and testing programs so that this work can be accomplished with the power off to the equipment.
   f. Capabilities to temporarily override of BACnet point values with built-in time expiration in the controller.
   g. BACnet MAC Address shall be set using decimal (0-9) based rotary switches.
   h. Configuration change shall not be made in a programming environment, but rather by a configuration page utilizing dropdown list, check boxes, and numeric boxes.
7. BACnet trending objects resident on controller.
   a. Minimum of 20,000 trending points total on controller.
   b. Shall be capable of trending all BACnet points used by controller.
   c. Shall be capable of 1 second sample rates on all points.
8. Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.
9. Transformer for the controller must be rated at minimum of 115% of ASC power consumption, and shall be fused or current limiting type. 24 VAC, +/- 15% nominal, 50-60 Hz, 24 VA plus binary output loads, for a maximum of 12 VA for each binary output.
10. Agency Approval: The controller shall have meet the Agency Compliance:
    a. UL916 PAZX, Open Energy Management Equipment.
    b. UL94-5V, Flammability.
    c. FCC Part 15, Subpart B, Class B Limit.

K. Trend Data Collection, Storage and Retrieval
1. The Building Automation System will be capable of collecting and storing point values for up to 25,000 data points. These will include a combination of hardware and software points. Data points collected will not only consist of the HVAC system but will also include energy tracking points as well as other pertinent systems information, including but not limited to wind, solar and ground water collection. The minimum frequency of this point collection will be 30 seconds and the maximum will be 2 hours. This setting will be selectable in a graphical wizard format by a system user.
2. Data storage and retrieving shall be set up by the Temperature Controls Contractor allowing the owner to create trends to aid in the troubleshooting of past system performance. The system provided by the Temperature Controls Contractor must have enough storage to save all of the data point values for up to a period of 5 Years.
3. Therefore the storage shall be sized to adequately save the data for 25000 points at the most frequent interval of 30 seconds over a 5 year time period. This data must be

retrievable in graphical and spreadsheet formats. The ability to graph multiple points for analysis shall be menu driven with an adjustable time value resolution selectable as: Minute, Hour, Day, Month to Date and Year to Date. These trends must be able to display up to 10 user defined point values on a single graph.

L. Enterprise Central Server (B-AWS) Software
1. Operating System:
a. The Enterprise Central Server shall run on most recent version of Microsoft Windows.
b. The B-AWS shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
2. Enterprise operator web interface:
a. The Enterprise operator web interface shall be accessible via a web browser without requiring any “plug-ins” (i.e. JAVA Runtime Environment (JRE), Adobe Flash).
b. The Enterprise operator web interface shall support the following Internet web browsers:
1) Internet Explorer 11.0+
2) Firefox 47.0+
3) Chrome 51.0+
4) Edge 13.0+
c. The Enterprise operator web interface shall support the following mobile web browsers:
1) iOS (iPad/iPhone) V9.1+
2) Android (Tablet) V4.3+
3) Android (Phone) V2.3+
3. Real-Time Displays. The B-AWS, shall at a minimum, support the following graphical features and functions:
a. Color graphic floor plan displays for each building, floor and zone controlled as well as system schematics for each piece of mechanical equipment, including air handling units, heat pumps, unit ventilators, fan coil units, blower coil units, terminal units, unitary equipment, exhaust fans, condenser water systems and hot water boiler systems, shall be provided by the temperature control contractor to optimize system performance analysis and speed alarm recognition. Rooms shall be color coded on the floor plan. The room color shall change based on temperature compared to the setpoint.
b. The contractor is responsible to use all room numbers developed and approved by the University in the development of the temperature control system for this building. The room numbers shall match room signage. University to sign-off on room numbers to be used before contractor is to input final numbers into BAS.
c. The sequence of operations shall be located as a pull down feature at each specific piece of equipment.
d. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands. Dynamic temperature values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.
e. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic

file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the B-AWS shall support the use of scanned pictures.

f. Graphic screens shall contain objects for text, real-time values, animation, color spectrum objects or “thermo-graphics”, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL’s, and links to other graphic screens. All start/stop points, setpoints, reset schedules, inputs and outputs for each system shall be shown on the graphic screens. All points shall be adjustable and shall have acceptable ranges shown.

g. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

h. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

i. Adjustments to analog objects, such as set points, shall be done by rightclicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

j. The sequence of operations, mechanical submittal, filter size and amount, and valve schedule shall be located as a pull down feature at each piece of equipment.

k. A snow day and hour delay buttons shall be placed on the front screen for ease of placing the system into unoccupied mode or to delay start times of warmup/cool down.

4. System Configuration. At a minimum, the B-AWS shall permit the operator to perform the following tasks, with proper password access:

a. Create, delete or modify control strategies.

b. Add/delete objects to the system.

c. Tune control loops through the adjustment of control loop parameters.

d. Enable or disable control strategies.

e. Generate hard copy records or control strategies on a printer.

f. Select points to be alarmable and define the alarm state.

g. Select points to be trended over a period of time and initiate the recording of values automatically.

5. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

6. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators’ access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

a. Owner utilizes MS Active Directory Services. Contractor shall coordinate with Owner’s IT department to incorporate Active Directory to the BAS system.

7. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

8. Alarm Console

a. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The

use of the Alarm Console can be enabled or disabled by the system administrator.

b. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

c. System shall be capable to send alarms to printer, email and via text message.

9. All sensors and devices shall be shown and labeled in the controls graphics. All labels shall match as-built drawings and actual installed tag designation.

M. B-AWS Display Frames

1. The Dynamic Graphic portion of this B-AWS shall allow the operator to access any system information via a “system penetration” method. “System penetration” shall allow the operator to penetrate into the facility until the detailed color graphic display of a specific area of the facility is represented. All system travel shall be 100% accessible via the mouse, no keyboard commands shall be necessary to edit dynamic data.
2. 2. The ability to import background images for the display frames shall include as a minimum, photos, digital images, bitmaps and standard image formats. Systems that utilize a proprietary background image format are not acceptable.
3. 3. As a minimum, a graphic display shall be provided for overall site, for each subsystem within the site and for all individual locations associated with each subsystem. All graphics shall be logically linked to allow the operator to traverse through the overall system and at any time return immediately to the associated subsystem, or overall site plan, via a graphic element.
4. 4. The system must be set up to have at least 3 access levels: guest, user and administrator. Guest privileges shall be limited to view only. Users shall be able to make setpoint and schedule changes. Administrators shall have all privileges as users in addition to being able to assign passwords.
5. 5. The graphic displays shall have an HTML tree on the left side of the screen and the currently viewed graphic on the right side. Tree views shall be different based on access level and the tree must only show screens that are available based on access privileges.
6. 6. Each AHU, heating water system and cooling system shall have a minimum of 5 graphic screens available from the tree view. One screen shall display the airflow pattern with all dampers, coils and fans shown in their correct schematic location and dynamic data for all input values shown. This main graphic screen shall show the control devices in mechanical flow diagram format with directional arrows to indicate normal flow arrangement. These screens shall be available to anyone with access to the system, and therefore shall be view only. Another screen shall display text information with the following primary categories: Unit status, temperatures, heating, cooling, economizer, static pressure, supply fan, exhaust fan including set screen shall also be furnished for each control loop, so that people with the appropriate access can change loop tuning parameters from PCs without needing individual programming tools. Override screens shall be furnished for each controller to permit overriding control points without the need for vendor specific software. An alarm screen shall also be furnished for each AHU. The Heating systems and Cooling systems shall have similar screens as the AHU. Each VAV shall have a graphics screen and a text screen. Systems that won’t permit creating these customized screens as described herein will not be acceptable. Systems that use controllers that won’t permit overrides of inputs and outputs from a browser based graphic screen will not be acceptable.
7. 7. All shapes shall be 3-D with a common perspective. All dampers shall have a minimum of 4 animation levels to show partially open, half open, mostly open, fully open, and closed position of dampers. All analog inputs shall show the actual value and engineering units on the graphic screen. Binary inputs shall be linked to flashing animated displays. Safety alarms will flash when in alarm. Filter status shall be indicated when value indicates that they are dirty. To prevent clutter on the graphic displays, symbols will only be shown for equipment that is controlled or monitored by the DDC system. Also, normal status for safeties will not be indicated, and normal status for

safeties will be indicated by an image of a clean filter. Pumps and fans shall rotate when flow is proven by a monitoring device. Coils shall change color when valves are open to permit water flow through the coils.

8. 8. Graphics shall use common color schemes to make the overall system easy to understand. All overall backgrounds shall be white. All text shall be black. Any value that is in alarm shall have a red background. Any value that is overridden shall have a blue background. All like sensors shall be the same color. For example, all temperature devices shall be yellow, all pressure devices shall be purple, all humidity devices shall be teal, all fire alarm devices shall be red, and all CO2 devices shall be green.
9. 9. Current set points and occupancy status shall be shown at the bottom of each graphic screen.
10. 10. Floor plan drawings shall be provided and permit access to each zone's individual floor plan sections. On the individual floor plan sections, room numbers and room temperatures shall be displayed. Values that are out of the acceptable range shall appear in a different background color and / or flash. Each VAV shall have its own graphic that contains the points from within its controller including the box flow set point, room temperature set point, maximum cooling flow set point, minimum cooling flow set point, and minimum heating flow set point, plus the discharge air temperature from the AHU supplying the unit. The VAV text screen shall have the same information as the graphic screen plus high and low flow calibration values, damper rotation adjustment (CW or CCW), and air balance set-up features. B-AWS shall permit operator the ability to enable, set or disable high and low occupied and unoccupied limits for each room temperature reading.
11. 11. Text Screens shall be available for all levels of access. Set point and output values are changeable from the text screen for users with appropriate access privileges and administrators, but not guests. When a value can be overridden or edited, a red box shall appear around it when the cursor is position on it. A single click of the mouse shall bring up pop up menu that provide options to make a permanent override, change set point, or release a previous override of an output point. Analog inputs shall have pop up menus that allow setting high and low alarm limits and the ability to enable and disable alarm limits as appropriate for the sensing device. Pop up menus must be customized to include a description of the point that is being modified. Generic override menus are not permitted because they would not describe to an operator what is about to be modified. The Control Contractor shall set up all initial alarms as indicated in the point matrix.
12. 12. Text screens shall include schedule information including current state and date and time of next scheduled event. Positioning the mouse over the current state shall permit single click access to the schedule. The schedule screen shall allow the operator to edit a yearly, weekly, daily, holiday or special event schedule for the system being viewed. Temperature values and set points shall be displayed below the schedule information, and shall have a minimum of 1 decimal place. Heating, cooling and damper out puts shall be displayed next. The OA temperature for economizer switchover shall be displayed and adjustable from the text screen. Air flow readings shall be shown with set point and actual readings. Fan information shall be shown next, followed by static pressure readings and set points, which shall have a minimum of 2 decimal places. Miscellaneous set points including night setback cooling and heating, average zone temperature, return air warm-up and cool-down, dehumidification, and unoccupied mixed air temperature set points shall all be shown and adjustable. All safeties shall be shown, followed by coil pump control information.
13. 13. Each system shall have its own specific alarm screen available to all operators but only editable by operators with user and administration access privileges. From the alarm screen, users and administrators shall be able to enable and disable alarms. Points that are in alarm shall have an alarm symbol highlighted in red. Points that are not in alarm shall be shown in gray. Alarms that are disabled shall have a way to indicate this on the alarm screen graphic.
14. 14. Loop tuning screens shall be available through the web browser interface to save the owner the cost and time associated with using vendor specific software for tuning loops. Access to these screens shall not be provided to guests. Air handling units shall have dedicated screens for discharge air temperature, static pressure, and outside air control loops. Loop tuning screen for discharge air temperature shall include the discharge air temperature, discharge air temperature set point, cooling loop throttling range, I-gain and

ramp time, heating loop throttling range, I-gain and ramp time, economizer loop throttling range, I-gain and ramp time, unoccupied heating loop throttling range, I-gain and ramp time, cooling valve output, heating valve output, and damper control output. Screens shall also have graphs that show 5 minutes of live data for the discharge air temperature, set point, cooling valve, heating valve and mixed air dampers. Each loop tuning screen shall include the appropriate throttling range, I-gain and ramp time.

15. 15. Each non-unitary controller shall have an override screen. These screens shall be available on-site for use during point-to-point check-out and commissioning. The override screen shall show the inputs and outputs for each controller with the points in their wired location. Unused points shall be shown as spares. Points that are in alarm shall have a red background, and points that are overridden shall have a blue background just as on other screens. These screens shall show the actual values that come back from the controller, not the values that may have been typed in for override at the B-AWS if the controller software is not accepting the override value. The override screen shall also permit timed overrides.
16. 16. Each VAV AHU shall also have a overview screen listing every VAV terminals data in a text format that includes occupancy mode, room temperature, room set point, box flow, flow set point, temperature leaving VAV terminal, % cooling and % heating. Also, each VAV AHU shall have an air balance screen that will permit balancing the system through a computer connected to the Ethernet or directly to the appropriate BC without vendor specific software. The air balancing screens shall permit at least 8 manual override commands: normal, position (%), flow value, flow percent, open, close, min flow, and max flow.
17. 17. Heating systems and cooling systems with multiple pieces of equipment such as pumps with lead-lag control shall display which device is lead and when the other device will become lead on the text screen.
18. 18. Although only one outside air temperature sensor is needed per building, the GUI shall use independent outside air temperature points, so that during check-out and commissioning, the outside air temperature for a system can be changed without changing the outside air temperature for the whole building. The B-AWS shall also have a global outside air temperature point that can be overridden from the screen for the controller where the point is physically connected. Overriding this outside air temperature value will change it for all systems, except when outside air temperature has been overridden for an individual system.
19. 19. The system shall allow for the easy development and editing of dynamic graphics. Wizards shall be utilized to assist the operator with their manipulation of the graphic system. The operator shall be able to, through a single mouse function, select between the dynamic display mode and the graphic edit mode for the currently viewed graphic frame, assuming appropriate access level is provided to the operator. Systems requiring multiple mouse or operator keyboard commands to enter the graphic edit mode are not desirable and require thorough definition of steps involved to accomplish function.
20. 20. Animation of system data shall be provided via graphic elements on the display frames. Standard graphic element library shall be provided to assist the operator with their implementation. The ability to define and add new animated graphic elements shall be provided. As a minimum, the ability to move, size, draw, arrange, align, layer, space, rotate, invert, duplicate, cut, copy, paste, erase any animated element shall be provided. System parameters and set points shall be assignable and modifiable by the animated graphic elements, relieving the need for keyboard commands for system manipulation.
21. 21. The ability to simultaneously display a dynamic X/Y chart of selected points, shall be provided. The chart shall be an element of the graphic display and shall automatically update with the display data. The chart shall allow for dynamic manipulation to modify the range, rate, and timeframe of view, in both a real-time as well as historical configuration. A minimum of 4 values shall be included on any chart display element. There shall not be a limit to the quantity of chart elements displayed on a graphic frame. Trace colors and X values shall be User configurable. Systems not providing this capability are required to provide an equivalent charting package with the B-AWS offering.
22. 22. Full on-line system documentation shall be provided. It shall not be necessary to maintain printed copies of user or programming manuals. Context sensitive help files shall be provided for all applications within the FMCS area of the B-AWS. The ability to

update on-line documentation must be provided via electronic updates, definition of update procedure shall be provided. Electronic O&M manual information shall be installed in the web server(s), so that information can be retrieved by logging on to the building's FMCS from any web browser. PDF files for control drawings, sequences of operations and product cut sheets shall be loaded on the web server(s), so they can also be remotely accessed.

23. 23. By pointing and clicking on any individual graphic element, the following shall be available for display or modification, but not be limited to the current value or state may be edited. A self- prompting pop-up window shall be displayed providing the ability to modify the selected point value. Instructions assisting the operator in their use of the pop-up window shall be provided.
24. 24. The ability to provide graphically displayed global scheduling and editing functions shall be provided. The ability to link these functions to the associated equipment or zone frames shall be a standard feature. A calendar shall be provided for display and modification of the SDC time clock functions. The User shall be able to view a daily, weekly, monthly, annual, special or holiday schedule from a defined display frame. A list of served areas shall be displayed on the same screen, this list shall be displayed at all times, pull down menus or other means of accessing these areas shall not be acceptable. The system shall have a master override screen that will allow an operator to change the schedule for every piece of equipment in every building by changing the master schedule. This is often referred to as a "Snow Day" command and does not require the operator to log onto each building's Subordinate Server and Building Controllers.
25. 25. The system shall have one "Home Page" located in the Master Enterprise Server. Access to all systems shall be available by logging on to the HVAC control system. An operator only needs to know this one URL, one user name and one password to access any system in the university. The "Home Page" will provide a tree view and text screen that shows every building in the univeristy that has web graphics of the HVAC system available. If the main server goes down, each controller at the local level shall have an outside accessible IP address, to allow remote access to each building.
26. 26. All analog values shall be trended every 15 minutes. The trend samples shall be saved in the BC for at least 36 hours. Access to trended data shall be available by the single click of a mouse on the analog value. Systems that open other windows and require a selection of the desired data are not acceptable.

N. B-AWS Alarming

1. The B-AWS shall provide, as standard, alarm annunciation of system data. On every display frame, the ability to view, acknowledge, delete and manipulate real-time and historical alarms shall be provided. The ability to provide a unique and custom alarm display for every display frame shall be provided. The ability to continuously or upon request, view the alarm display, shall be provided.
2. Alarm conditions shall be capable of invoking, as a minimum; a display frame, an email message, a text message sent to a pager or cellular phone.
3. Alarm logging shall be provided in a user definable configuration. All alarms shall be displayed and/or routed as follows, as a minimum; B-AWS display frame, local printer, server printer, client printer, logged to file, and archived in standard format for information management. Alarm groupings shall be hierarchical in nature allowing up to 8 alarm groups and 16 sub-groups. The B-AWS shall not possess any limits on the quantity of alarms that can be logged, including historical data archiving. Systems possessing limits must define the restrictions and may not be acceptable.
4. Alarm provide shall provide up to 999 alarm priorities with up to 5 alarm color changes, per priority, according to alarm status.

O. B-AWS Trending

1. The B-AWS shall automatically perform time based, user defined, periodic collection of real time point data. The data shall be presented as an X/Y chart in the display frame. The data shall be stored and archived in a file format that allows for the manipulation and utilization of the data by third party applications.
2. A dynamic trend shall be defined as a group of at least 4 data points, with a circular buffer of 2000 data points. A historical trend shall be defined as a group of at least 8 data points, with the sampled points limited only by archival disk space. Sampling rates shall

be user selectable from instantaneous (one per second) to once a week. Collection of data shall be user selectable to start and stop on a specific time and date. There shall be no limit to the number of X/Y charts within a display frame.

3. X/Y charting and column and row reporting shall be an integral part of the HMI. All points shall be chartable or reportable. Analytical data shall be displayed for any of the selected points in a clearly displayed X/Y chart. This analytical data shall consist of at least the following: Average Mean, Standard Deviation, Simple Average, Current Value, Cycle Length, Cycle High and Cycle Low.
4. X/Y charting shall provide for the following chart manipulation: display, zoom, scroll, centering, pen legend and export to Excel, Text via Dynamic Data Exchange.

P. Web Browser Clients

1. The system shall be capable of supporting up to 25 simultaneous clients using a standard Web browser such as Internet Explorer™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
2. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the BAS, shall not be acceptable.
3. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Enterprise Central Server (B-AWS). Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
4. The Web browser client shall support at a minimum, the following functions:
    a. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
    b. Graphical screens developed for the B-AWS shall be the same screens used for the Web browser client. Any animated graphical objects supported by the B-AWS shall be supported by the Web browser interface.
    c. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
    d. Storage of the graphical screens shall be in the System/Building Controller (B-BC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
    e. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
    f. User’s shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
        1) Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
            a) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
            b) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
        2) Commands to start and stop binary objects shall be done by right clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
        3) View logs and charts
        4) View and acknowledge alarms.

g. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

h. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

Q. Server Functions and Hardware

1. A central server, located at the existing Administrative Services building and shall be provided by the Owner to store data. The server shall support all System/Building Controllers (B-BC) connected to the Owner's network whether local or remote.
2. Central Server Components
    a. The central physical or virtual server shall consist of the following (minimum):
        1) Two 3.0 GHz, Quad Core Processors
        2) 8GB, DDR266 SDRAM memory
        3) Hard drive 73 GB RAID-5
        4) Microsoft Windows Server 2012/2014
        5) Microsoft SQL Server 2008/2012
        6) NET Framework V 3.5, 4.0
        7) TCP/IP Interface
3. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.
4. It shall be possible to provide access to all System/Building Controllers via a single connection to the server. In this configuration, each System/Building Controller can be accessed from the Enterprise Central Server (B-AWS) or from a standard Web browser (WBI) by connecting to the server.
5. The server shall provide the following functions, at a minimum:
    a. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
    b. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any (B-BC) in the network, local or remote.
    c. The server shall include a master clock service for its subsystems and provide time synchronization for all System/Building Controllers (B-BC).
    d. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
    e. The server shall provide master scheduling for all System/Building Controllers and their underlying field control devices.
    f. The server shall provide demand limiting that operates across all System/Building Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
    g. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to System/Building Controllers. Systems not employing this prioritization shall not be accepted.
    h. Each System/Building Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
    i. The server shall provide central alarm management for all System/Building Controllers supported by the server. Alarm management shall include:
        1) Routing of alarms to display, printer, email and pagers
        2) View and acknowledge of alarms

3) Query alarm logs based on user-defined parameters.

j. The server shall provide central management of log data for all System/Building Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
   1) Viewing and printing log data
   2) Exporting log data to other software applications
   3) Query log data based on user-defined parameters

k. Server Hardware Requirements: Coordinate the server requirements with the Owner:
   1) Connection to the BAS network shall be via an Ethernet network interface card, 100 Mbps or 1 Gbps.

R. System Programming

1. The Enterprise Central Server (B-AWS) software shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the B-AWS shall be through password access as assigned by the system administrator.
2. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Enterprise Central Server (B-AWS) screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide “realtime” data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface display shall not be acceptable.
3. Programming Methods
   a. Provide the capability to copy objects from the supplied libraries, or from a userdefined library to the user’s application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
   b. Configuration of each object will be done through the object’s property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
   c. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
   d. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
   e. The system shall support object duplication within a customer’s database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

S. BACnet Network Management

1. The Enterprise Central Server (B-AWS) software shall provide a complete set of integrated BACnet network management tools for working with BACnet networks. These

tools shall manage a database for all BACnet devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between BACnet devices, known as “binding”. Systems requiring the use of third party BACnet network management tools shall not be accepted.

2. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
3. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.
4. These tools shall provide the ability to “learn” an existing BACnet network, regardless of what network management tool(s) were used to install the existing network, so that existing BACnet devices and newly added devices are part of a single network management database.
5. The network management database shall be resident in the System/Building Controller (B-BC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, within the control system shall not be accepted.

T. Object Libraries

1. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
2. The objects in this library shall be capable of being copied and pasted into the user’s database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
3. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.
4. All control objects shall conform to the control objects specified in the BACnet specification.
5. The library shall include applications or objects for the following functions, at a minimum:
    a. Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
    b. Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical “point-and-click” selection. This object must be “linkable” to any or all scheduling objects for effective event control.
    c. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals
    d. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
    e. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building’s “flywheel” effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day’s performance.
    f. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy

utility (electric, oil, gas and water). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

6. 6. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.
    a. Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
    b. Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.
    c. Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an “on” condition. The user must be able to specify either input condition as the “on” condition.
    d. Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.
    e. PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
    f. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
    g. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
    h. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string

manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.

i. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

j. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an “On” state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.

k. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphical shell of this container.

7. 7. The object library shall include objects to support the integration of devices connected to the System/Building Controller (B-BC). At a minimum, provide the following as part of the standard library included with the programming software:

a. BACnet devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide BACnet manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the BACnet profile shall be supported. Information (type and function) regarding network variables not defined in the BACnet profile shall be provided by the device manufacturer.

b. For devices not conforming to the BACnet standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file and documentation for the device to facilitate device integration.

c. For BACnet devices, provide the following objects at a minimum:

1) BACnet AI
2) BACnet AO
3) BACnet BI
4) BACnet BO
5) BACnet Device

d. For each BACnet object, provide the ability to assign the object to a BACnet device and object’s instance number.

2.10 TEMPERATURE CONTROL WIRING

A. Cabling in air plenums shall be open wired UL listed plenum cable or shall be installed in conduit.

B. Conduit shall be 1/2-inch minimum size and shall be furnished and installed by the temperature control contractor. Run all control wiring exposed in mechanical rooms and similar spaces in conduit, in a neat, workmanlike manner. Provide bushings on any open end of conduit. Conduit construction and sizing shall be in accordance with Project Manual Section 260533, Raceway and Boxes for Electrical Systems.

C. Concealed wiring and wiring in non-plenum ceiling cavities, which is operating under 100 volts, may be open wired if in compliance with Article 725, NFPA-70 (NEC). Open wiring shall be supported as denoted below.

D. Terminations shall be performed by the Temperature Control Contractor.

E. Wire and conduit not indicated on the Drawings or in the Specifications, but required by the controls supplier, shall be paid for by the Temperature Control Contractor at no additional cost to the Owner.

F. Cable Supports
1. Provide cable supports that meet UL, NEC and TIA/EIA requirements for structured cabling systems.
2. The cable support system shall provide support for various types of low voltage cables, fiber optic cables, innerduct, and temperature control cabling.
3. The support system shall attach to the building structural elements or be wall mounted.
4. The supports shall be made of fire retardant and low smoke emission products, which meet UL 2034 requirements for air plenum spaces.
5. The support products shall have a minimum of a 1 inch wide platform for the cable to rest. Bridle rings or bridle rings with 1” inserts are not acceptable.
6. Individual supports shall be installed at intervals not greater than 60 inches.
7. Cable supports shall be installed a minimum of 6 inches above lay-in ceiling system. Cable sags shall not allow the cable to touch ceiling grid or tiles.
8. Minimum clearances from sources of EMI and RFI must be as specified in TIA/EIA-568C, TIA/EIA-569 and the latest version of the BICSI TDMM.
9. Approved Manufacturers:
    a. Caddy by Erico
    b. Siemon
    c. CPI
    d. Panduit
    e. Garvin Industries
    f. B-line

G. Cable Ties
1. Provide plenum rated cable ties for cables in/or above ceiling.
2. Cable ties shall be of appropriate length to loosely bundle and secure the low-voltage cables. Cable ties are not to be pulled so tight that they damage or distort the cables in the bundles. Trim cable tie loose ends.
3. Cable ties shall meet UL 94V-O.
4. Approved Manufacturers:
    a. Panduit
    b. Hubbell
    c. Leviton

H. Cable Hook and Loop Fasteners
1. Provide cable hook and loop fasteners to secure cable bundle at equipment cabinets, panels, and controllers.
2. Hook and loop fasteners may be used above ceiling if they are plenum rated.
3. UL listed.
4. Approved Manufacturers:
    a. Panduit
    b. Hubbell
    c. Leviton

I. Innerduct (Indoor)
   1. Provide 1.0 inch I.D. plenum rated corrugated innerduct above ceiling for all non-armored fiber optic cable.
   2. Innerduct shall be UL listed and plenum rated.
   3. Approved Manufacturers:
      a. Endot-Endocor
      b. Carlon
      c. Pyramid Industries
      d. Eastern

J. Innerduct (Outdoor)
   1. Provide 1.0 inch I.D. non-plenum polyethylene-type, ribbed inside tube, innerduct in the conduit as shown on the Drawings.
   2. Innerduct shall be UL listed.
   3. Provide a nylon pull string in all empty innerduct runs.
   4. Approved Manufacturers:
      a. Enduct Ribbed (for outside applications)
      b. Carlon
      c. Pyramid Industries
      d. Eastern

K. Temperature Control Contractor shall refer to all Divisions 23 and 26 Project Manual sections for unique requirements for each piece of equipment.

L. Wireless Network
   1. The network shall utilize a wireless network for communications throughout the BAS.
   2. The wireless network shall be a redundant, self-repairing wireless mesh network utilizing BACnet protocol over ZigBee Building Automation Standards and shall conform to IEEE 802.15.4 Standards.
   3. Communication between equipment controllers shall conform to ZigBee Building Automation (ZBA) standard as BACnet tunneling devices.
   4. The wireless network shall not cause interference with building WI-FI, Bluetooth, RF, or other communications networks. Any identified interference shall be corrected at no cost to the Owner, up to and including replacement of the wireless network with a fully hard wired system.
   5. The wireless network shall include wireless controllers and sensors as required for a complete, operable system, complying with all requirements of the BAS and Sequence of Operations.
   6. Wireless Zone Sensors
      a. Battery life shall be 15 years or greater to minimize the need for battery replacement in typical operating conditions.
      b. b. To check for proper operation, wireless space temperature sensors shall include a signal strength on the space sensor display.
      c. c. To allow local troubleshooting without specialized tools, error codes shall be displayed on the digital display. Error codes shall include: not associated, address to 000, improper software configuration, input voltage too high, or general sensor failure. Codes shall be indicated on inside of sensor back cover.
      d. d. To support use by the physically impaired, the wireless space sensor shall be a minimum font size of 12 points, and the LCD model shall be readable in low light conditions.
      e. e. An optional 2% relative humidity sensors module shall be available for humidity control applications to minimize the need for wired sensors, and shall not shorten typical battery life to less than 15 years.

PART 3 - EXECUTION

3.1 INSTALLATION

A. DDC Global Control Panels for network control and building interface shall be as required for each building.

B. Provide a separate DDC Controller for individual HVAC mechanical equipment. DDC Controllers shall be mounted, installed, and wired by controls contractor as specified. BAS manufacturer shall furnish and coordinate DDC controllers and control devices and ensure that installation and wiring adhere to BAS manufacturer's design recommendations. The BAS manufacturer shall field mount controls and coordinate all installation and termination information to ensure the specified sequence of operations are met.
   1. Side loop control for single point devices such as cabinet heaters, exhaust fans, convectors etc., is allowed.

C. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 10% spare I/O point capacity for each point type (analog or digital) found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used in each controller

D. Control of the equipment, including air handling units, along with all other scheduled equipment shall be accomplished through DDC control.

E. All sensors and devices shall be labeled. All labels and designations shall match designations in controls software and as-built drawings.

F. DDC Global Control Panel for network control and building interface shall be located as required for each building.

G. The Temperature Control Contractor shall provide direct communication between the DDC/BAS System and the variable frequency drives. The data from the variable frequency drives on fans and pumps including drive power data such as minimum voltage, current and frequency shall be available for data collection and trending at the DDC/BAS System workstation.

H. Mount all wall mounted sensing devices at +4'-8" A.F.F. to the bottom of the device unless noted otherwise on the drawings.

I. Temperature Control Cabling
   1. Cabling shall be supported by products that meet BICSI, EIA, TIA requirements or installed in cable tray.
   2. Where denoted on the drawings, sleeves and cable trays shown on the Technology drawings may be used by the Temperature Control Contractor as detailed; however their use is strictly voluntary. Deviation from these pathways is acceptable but any additional sleeves, coring, supports etc are the responsibility of this contractor. Deviations must be clearly noted on the Record Drawings.
   3. Materials installed under this Specification shall be attached to the building structure, independent of other pipe, duct, equipment, ceiling grid, or other installations. Cable supports are not to be attached to ceiling grid wires or fire sprinkler piping supports. Cables are not to rest on or be supported by masonry or other building structural members.
   4. Cables in exposed ceiling areas such as auditorium, gymnasium, art rooms, classrooms, locker rooms, corridors, etc. shall be installed in conduit from the device to the nearest accessible lay-in ceiling or the nearest telecommunication room. The Temperature Control Contractor is responsible for coordinating these conduit installations to minimize cable distances.

5. Cables installed in rooms with architectural “clouds” may be installed without conduit but the cabling must be routed so that it cannot be seen from the floor.

3.2 SEQUENCE OF OPERATION

A. Refer to Specification Section 230993 for all equipment sequences of operation.

3.3 OCCUPIED/UNOCCUPIED ZONES

A. The following shall be the accepted zone control. Zone control shall include all units designated in sequence of operation. All zones to include capabilities through the Building Automation System for override setting to full occupied cycle during unoccupied cycle.

3.4 GUARANTEE/WARRANTY

A. It is intended that the Contractor include as part of his bid one (1) year full service warranty. All labor and material shall be guaranteed against defects in workmanship for the one (1) year period from the date of Substantial Completion as determined by Architect/Engineer. Any material proving defective shall be repaired or replaced during that period. This shall not, however, apply to material that has been damaged due to willful negligence.

B. The Contractor will provide hardware and software support during the one (1) year guarantee after the date of acceptance. Hardware support includes replacing of any major or minor components, relays, sensors, etc., that fail to operate properly. Software support includes upgrading of software during warranty period such that system is loaded with latest available revision at end of warranty period.

C. Support is also defined to include Owner personnel training needed to operate the system effectively as outlined in this Specification. Explicitly included is the training needed to analyze a building's operation with a view to minimizing energy costs.

D. Preventative Material and Labor Warranty
   1. The Contractor shall clean, adjust and re-calibrate to maintain integrity and performance as originally accepted, on a regular basis.
   2. Provide all necessary Node and software updates to ensure all software is at the current revision.
   3. Maintain a record on-site of all work done, all items removed from site, all items returned to site, all new replacement items installed and all remedial programming and database entry work undertaken including software revisions installed. Maintain a record of all calibrations done.
   4. Contractor is to have a qualified employee on-site within 4 hours from the receipt of an emergency service call, Monday through Friday, between 8 AM and 5 PM. The Contractor must have the capability to respond after normal working hours if required.
   5. All costs for after-hours work will be invoiced to the Owner, except the work attributable to the contractor’s responsibility above and beyond this contract.
   6. Just prior to the termination of the special guarantee and warrantee period, the Control Contractor shall again thoroughly check, and recalibrate at required, the complete installation.
   7. Provide detailed description of warranty in O&M Manual.

3.5 OWNERSHIP OF PROPRIETARY MATERIAL

A. The owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. All project developed software and documentation shall become the property of the owner. These include, but are not limited to project graphic images, record drawings, project database, project specific application programming code, and all other associated documentation.

B. Ownership of Proprietary Materials, such as Controller and Database Software backups are to be housed at the school.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
   1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
   2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 4 hours dedicated instructor time on-site.
   3. Review data in maintenance manuals.
   4. Schedule training with Owner, through Architect/Engineer, with at least seven days' advance notice.

3.7 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to two Project site visits (minimum of 4 hours per site visit), when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions. This time is in addition to time necessary for warranty related work.
   1. If the above site visits are not utilized by the owner, the contractor is to visit each building during the first heating or cooling season to make repairs and adjustments to provide uniform conditions throughout.
   2. Prepare and submit a report for each visit documenting conditions found and corrective action taken. Report to be signed by owner for documentation.

3.8 TRAINING OF SCHOOL OPERATOR

A. The Temperature Control Contractor shall, during the one-year guarantee period, provide onsite training. No less than (1) 4-hour training sessions shall be held at the site during and after each system is in full operation.

B. Contractor should make arrangements to accommodate multiple university attendees at each training session. No limit shall be set on number of university attendees. At least one week notice shall be given to University to schedule training session, at the university's discretion.

C. Obtain a receipt acknowledging completion of each item of instruction.

3.9 COMPLETION

A. Prior to final inspection, this Contractor shall perform the following service work, including, but not limited to, the following items:
   1. Check damper travel, adjust and tighten set screws.

2. Calibration of instruments.
3. Check and verify circuitry.
4. Calibrate and checkout controllers, fusing, etc.
5. Test and debug microprocessor and software.

B. When the work is completed, and at a time directed by the Owner or the Architect/Engineer, the Contractor shall carefully adjust all parts of the equipment and systems. This includes adjustment of automatic controls and safety devices, proper setting of adjustable devices, dampers and valves, and other necessary operations so the systems are fully operable and automatic in operation. Upon completion of the Work, notify the Owner, and/or Architect/Engineer that system is ready for final tests and inspection.

C. At the time of final inspection, this Contractor shall be represented by a person with the proper authority, who shall demonstrate, as directed by the Architect/Engineer, that his Work fully complies with the purpose and intent of the Specifications and Drawings. Labor, services, instruments, and tools necessary for demonstrations and tests shall be provided by the Contractor.

D. The Contractor shall test and adjust each instrument specialty and equipment furnished by him, prior to final acceptance. The Contractor shall demonstrate, for approval by the Architect/Engineer, that subsystems operate as a coordinated and properly functioning, integrated system.

E. The Contractor shall furnish labor, provide adjustments and incidentals necessary to obtain the desired and intended results.

F. The Contractor shall turn over a printed copy and electronic copy of the completed and debugged operating software to the Owner at the conclusion of the warranty and extended preventative material and labor warranty.

END OF SECTION 23 09 00

SECTION 23 09 93 - HVAC SEQUENCE OF OPERATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Division 01 Section “Alternates” that may affect the Work of this Section.

B. Refer to the details and schedules on the Drawings for additional requirements.

1.2 SECTION INCLUDES

A. This Section includes the sequences of operation for the HVAC equipment and systems.

B. The Temperature Control Contractor shall read all other Drawings and Specifications, become familiar with requirements and scope of the Project, and include such coordination work as may be required.

C. Sequences of operation shall meet or exceed the requirements of ASHRAE standard 90.1.

1.3 SUBMITTALS

A. Submittals are required and shall include detailed descriptions of the proposed sequence of operations for all HVAC systems specific to the project.

1.4 BUILDING SET POINTS

A. All set points and other variables noted in the sequences are to be adjustable from the web accessible graphical user interface so that the owner does not have to go to the school or open any programming software to change the settings. Access to the adjustable settings shall be password protected and an audit log shall track who made what changes and when they were made.

B. Refer to sequence of operations of individual equipment for set points specific to each designated zone.

Winter Design:

Occupied Mode	**Unoccupied Mode**
68 deg. F	55 deg. F

Summer Design:

Occupied Mode	**Unoccupied Mode**
74 deg. F, 60 percent RH	85 deg. F, 60 percent RH

1.5 EXISTING SEQUENCE OF OPERATIONS

A. The Temperature Controls Contractor shall verify all existing sequence of operations for all equipment prior to removing existing controls. In the absence of an existing sequence of operation, the Temperature Control Contractor shall use the sequence of operation listed below. The Temperature Control Contractor shall review the sequence of operation with the Architect/Engineer and the Owner prior to the installation.

1.6 SEQUENCE OF OPERATION

A. Variable Air Volume Air Handling Units:
   1. Provide a microprocessor based direct digital control system that shall provide the following:
      a. Direct Digital Controller interface.
      b. Occupied-unoccupied control.
      c. Necessary operating interlocks.

2. Heating Warm-Up
   a. The system shall be enabled with an optimum start schedule 2 hours maximum (adj.) prior to the start of occupied mode.
   b. The supply fan will run. The heating water valve shall be opened to provide 85 degrees F. (adj.) discharge air temperature.
   c. The outside air damper and outside air dampers shall remain closed until the return air temperature is within the heating mode of control (68 degrees F adj.). The return damper shall be full open.
   d. When the return air temperature reaches 68 degrees F, the unit shall index to standby mode. In standby mode, the unit shall assume the occupied sequence of operation, while the outdoor air damper remains closed. The unit shall remain in standby mode until indexed to occupied mode by the occupied schedule, the outside air damper shall be ramped open and the return air damper shall be ramped closed linearly over a 10 minute (adj.) period to prevent "nuisance" low limit alarms.
   e. Fan powered VAV terminals shall be started 5 minutes (adj.) prior to start of supply fan.
   f. The VAV reheat controller assumes the occupied mode of operation, reverses the control action of the damper to modulate the air flow between maximum flow and reheat minimum flow values to maintain the zone temperature. The heating valve supplements the warm air available from the air handling unit. When the zone temperature reaches set-point, the system will automatically index to occupied cycle.
3. Cooling Pull-Down
   a. The system shall be enabled with an optimum start schedule 2 hours maximum (adj.) prior to the start of occupied mode.
   b. The supply fan will run
   c. If the outside air can be used as determined through an enthalpy controlled economizer for cooling pull-down, the outside air damper shall be open during the pull-down cycle. If the outside air enthalpy is such that it cannot be used for cooling pull-down, the outside air damper shall remain closed and the chilled water control valve open until the return air temperature reaches 77 degrees F (adj.). The return damper shall be full open. Chilled water control valve and outside air damper shall modulate to maintain a unit leaving air temperature above 55 degrees F (adj.).
   d. The VVR terminals shall be indexed to full airflow and the associated reheat coils shall be fully closed.
   e. When the return air temperature reaches 77 degrees F (adj.), the unit shall index to standby mode. In standby mode, the unit shall assume the occupied sequence of operation, while the outdoor air damper remains closed. The unit shall remain in standby mode until indexed to occupied mode by the occupied schedule, the outside air damper shall be ramped open and the return air damper shall be ramped closed linearly over a 10 minute (adj.) period to prevent "nuisance" low limit alarms.
4. Occupied Cycle
   a. The supply fan shall run continuously. The supply fan variable frequency controller shall be modulated via a signal from the direct digital controller. A duct static pressure signal located near the end of each primary duct run shall send a signal to the direct digital controller, with the lowest pressure driving the controller. The DDC controller shall monitor the fan speed and modulate the VFC accordingly.
   b. On an increase or decrease in required system air flow, the return air damper shall modulate as necessary to reduce return air flow and maintain the minimum outside air quantities as scheduled on the Drawings. Airflow monitoring stations located in the outside air stream shall monitor the quantity of outside air entering the building. An alarm shall be generated anytime the outside airflow is below the defined minimum outside airflow (adj.). The minimum variable frequency controller set point shall be as required to meet the minimum outside air requirements. At minimum air flow, the outside air damper shall be open and the return air damper shall be closed.
   c. Discharge air temperature shall be maintained by staging the cooling and

heating water control valve in association with an enthalpy controlled economizer. Discharge air temperature reset shall be employed per the following schedule. The temperature control system to determine critical space via a calculation as follows:

$$CoolingDemand\% = \frac{(actual_flow_rate - \min imum_flow_rate)}{(\max imum_flow_rate - \min imum_flow_rate)} * 100$$

1) DAT is 55 deg F (adj.). When the critical zone cooling demand is 50%, the SAT is 62 deg F (adj.). When the critical zone cooling demand is 100%, supply air temperature (SAT)
2) Control system to evaluate every 5 minutes (adj). If any zone is above 90% (adj.) cooling demand, decrease SAT by 1 deg F. If no zone is greater than 80% (adj.), increase SAT by 1 deg F.

d. A mixed air low limit sensor shall modulate the outside air damper and the return air damper through the DDC controller to maintain the minimum mixed air temperature at 45 deg F (adj.) to keep the unit from shutting down on low limit freeze protection. The sensor shall be installed in a serpentine manner to cover as much surface area as possible.

e. Outside air enthalpy below return air enthalpy
1) Upon a rise in discharge air temperature, the outside air damper shall modulate open, as required to maintain discharge air temperature.
2) On a continued rise in discharge air temperature, with the outside air damper 100 percent open, the chilled water coil shall modulate open as required to maintain discharge air temperature.
3) Upon a drop in discharge air temperature, the chilled water control valve shall modulate closed as required to maintain discharge air temperature.
4) Upon a continued drop in discharge air temperature, with the chilled water valve closed, the outside air damper shall modulate to its minimum position as required to maintain discharge air temperature.
5) Upon a continued drop in discharge air temperature, with the chilled water valve closed, outside air damper at their minimum position , the heating water valve shall modulate as required to maintain discharge air temperature.
6) Upon a rise in space humidity above 60 percent RH (adj.), and the outdoor air temperature below 50 degrees F. (adj.), the outside air damper shall modulate open, and the heating water control valve shall be modulated to maintain space temperature.

f. Outside air enthalpy above return air enthalpy
1) Upon a rise in discharge air temperature, the chilled water control valve shall modulate as required to maintain discharge air temperature.
2) Upon a drop in discharge air temperature, the chilled water control valve shall modulate closed as required to maintain discharge air temperature.
3) Upon a rise in space humidity above 60 percent RH (adj.), the outside air damper shall remain at its minimum position, the chilled water control valve shall be opened to maintain a unit leaving air temperature above 55 degrees F (adj.), and the terminal unit heating water control valves shall be modulated to maintain space temperature. The BAS shall generate an alarm if it does not permit the unit to enter the dehumidification mode because it detects that the Hot Water System is not enabled and cannot provide the reheat necessary for dehumidification. A visible graphic to be displayed on the BAS.

g. Static pressure shall be reset by modulating the supply fan variable frequency controller via a signal from the direct digital controller. Static pressure reset shall be employed based on the zone level VAV damper position. Static pressure reset shall be employed per the following schedule. All variables for the reset schedule shall be adjustable.

1) The controller shall measure duct static pressure and modulate the supply fan VFC speed to maintain a duct static pressure set point. The speed shall not drop below 30% (adj.).
2) The static pressure set point shall be reset based on VAV damper location. VAV damper position will be known by polling the terminal units every 10 minutes (adj.). All VAV damper position must be verified by BAS.
3) The initial duct static pressure set point shall be 1.5 in. (adj.)
4) If the most open terminal unit is more than 95% (adj.) open, the static pressure set point shall be increased by 0.1".
5) If the most open terminal unit is between 90% (adj.) and 95%, (adj.) no change is to occur.
6) If the most open terminal unit is less than 90% (adj.) open, the static pressure set point shall be reduced by 0.1".
7) The set point shall incrementally reset up to a maximum of 1.8 in. (adj.).
8) The set point shall incrementally reset down to a minimum of 1.3 in. (adj.).

5. Unoccupied Cycle
   a. The direct digital controller shall automatically program the unit to the unoccupied control mode.
   b. The unit may be manually placed into full occupied cycle during unoccupied time through the DDC controller for a pre-programmed period of time (adj.).
   c. Upon entering the unoccupied mode, the outside air damper shall be closed, the fans and heat wheel shall not run, and the relief, outside air bypass, exhaust air bypass, and return air dampers shall be open.
   d. A space mounted humidity sensor(s) will enable the unit and shall place the unit into dehumidification mode anytime the space humidity rises above 60 percent RH (adj.) during unoccupied cycle. The supply fan shall run and the cooling coil control valve shall be opened to maintain a supply air temperature above 55 degrees (min.). The VAV terminals shall be indexed to occupied mode. The VAV terminals primary air dampers and heating water control valves shall be modulated to maintain reduced unoccupied space temperatures. If the outside air enthalpy is below the return air enthalpy, outside air shall be used in conjunction with the chilled water coil. If the outside air enthalpy is above the return air enthalpy, the outside air damper shall remain closed. Once the space humidity level reaches set-point, the system shall return to unoccupied mode. Minimum unit run-time of 30 min. (adj.) is required.
      1) The BAS shall generate an alarm if it does not permit the unit to enter the dehumidification mode because it detects that the Hot Water System is not enabled and cannot provide the reheat necessary for dehumidification. A visible graphic to be displayed on the BAS.
   e. Should (2) or more VAV terminal unit space temperatures fall below the unoccupied heating set-point or one below 50 degrees (adj.), the BAS shall start the supply fan and modulate the VFC accordingly. Once enabled, the supply fan shall operate for a minimum of 30 minutes (adj.). The outside air damper shall remain closed with the return air damper open and the heat wheel off. The respective VAV terminal unit requiring heat shall modulate its primary air damper and heating water control valve to maintain the reduced unoccupied space temperature set –point.
   f. A night purge cycle shall be utilized during the cooling mode any time the outdoor air enthalpy is below the indoor air enthalpy. The system shall utilize 100 percent outside air economizer to purge the building and reduce the indoor air enthalpy. Duct static pressure set-point will be a .75"W.C. during this cycle. Night purge to be utilized from 4 hours before to 2 hours before scheduled occupancy (adj.). Maintain a unit leaving air temperature above 55 degrees F (adj.).

g. When the outside air temperature is below 35 degrees F. (adj.), the heating water control valve shall be modulated to maintain 65 degrees F. (adj.) air handling unit cabinet temperature as determined by the mixed air temperature sensor.

6. Safeties
   a. Provide an automatic software reset safety high limit in the discharge air duct to stop the supply fan, exhaust fan, and heat wheel if discharge static pressure goes above 6 inches W.C. (adj.). System shall be capable of being reset through software at the temperature control computer.
   b. Provide an automatic software reset safety low limit thermostat upstream of cooling coils and downstream of heating coils set to close the outside air damper, open the heating coil valve full, stop the supply fan, exhaust fan and heat wheel if the air temperature drops below 38 degrees (adj.). System shall automatically reset when freezing condition has been eliminated. Provide software to lock out the unit if the low limit trips and resets itself three times without being reset by an authorized operator through the web graphics.
   c. Provide individual differential pressure sensing across both pre-filters and primary air filters and send alarm to BAS panel requesting filter change. Include independent alarm for each filter bank at each air handling unit. Pre-filters and primary filters shall be monitored independently. Alarms and set-points shall be capable of being reset through software at the temperature control computer. A software adjustment is to be utilized to accurately represent the “dirtiness” of filters when airflow is below maximum.
   d. The system provided must be capable of manually positioning all damper operators, and the cooling and heating valve actuators, if all levels of DDC control fail.
   e. A fan proving device will indicate the fan status for each fan and send an alarm to the central BAS panel indicating fan failure.
   f. Provide a manual reset differential pressure switch in return air and outside air mixing box section to stop supply fan, exhaust fan, and heat wheel upon detection of outside air and/or return air control damper failure. Static set point to be adjustable.
   g. Monitor mixed air temperature, outdoor air inlet temperature, supply air temperature, return air temperature, heat wheel leaving air temperature (both exhaust and outside), return air humidity and CO2 in addition to all sensors required to meet sequences.
   h. Monitor heating water and chilled water control valve location, in addition to all sensors required to meet sequences.
   i. All safeties must be reset prior to fans operating in either automatic or Hand mode.
   j. Maintain a unit leaving air temperature above 55 degrees F (adj.) in all modes.
7. Contractor shall provide a humidity sensor for each temperature control zone, as indicated in the control drawings. Humidity reading shall be viewable as part of the AHU graphics. If a sensor detects humidity levels in excess of set-point, an alarm shall be sent to the BAS.
8. Contractor shall provide a carbon dioxide (CO2) sensor in the main return air duct(s) to the air handler for each floor. Carbon dioxide reading shall be viewable as part of the AHU graphics. If a sensor detects CO2 levels in excess of 1500ppm (adj.), an alarm shall be sent to the BAS.

B. Boiler and Heating Water Pumps
1. Provide a microprocessor based direct digital control system that shall provide the following:
   a. Boilers and heating water pumps shall be enabled from the BAS, to operate based on the following outside air temperature schedule by the BAS. Boilers and pumps operation, supply and return temperature, and flow shall be monitored and alarmed through the BAS, via integration with the equipment.
   b. The boilers shall have a boiler controller furnished by the Temperature Control Contractor. The boiler controller shall interface directly to the BMS system. Coordinate with the boiler manufacturer for information on point scaling, override, and set-point control capabilities.

c. Mounting and wiring of the boiler controller shall be provided by the Contractor.

d. All available point information from the heating water system shall be routed to the BAS.

e. The boilers high and low temperature alarms, low water cutoff, flow switch, and flame failure shall be routed to the BAS.

f. The pump status shall be monitored by a current sensing relay. If the lead pump fails to start or is not confirmed within two minutes after the command to start has been initiated through the BAS, the standby pump shall be indexed to start and an alarm shall be initiated.

g. Provide automatic alternating lead/lag operation through the BAS.

h. The building heating water supply temperature sensor and the outside air temperature sensor, through the DDC/BAS output signal, shall modulate the heating water supply temperature to maintain the following supply temperature reset schedule in a linear sequence.

Heating Water Supply Temperature	O.A.Temperature
180 Degrees F (adj.)	<20 degrees F (adj.)
140 Degrees F (adj.)	60 degrees F (adj.)
100 Degrees F (adj.)	Above 60 degrees F (adj.)

i. The heating water temperature reset shall be controlled either by condesning boiler controls, or by the use of a system 3-way temperature reset valve if the system utilizes non-condensing boilers. The water temperature shall not create condensing situations in non-condensing boilers.

j. The Contractor to furnish flow switch, and temperature sensors for heating water system required by boiler manufacturer, and instruct Installing Contractor on proper location and proper installation of the temperature sensors. The Contractor to wire between all devices and control panels.

k. When the heating water system is enabled, the lead boiler module shall start and fire. The unit shall increase input until the input reaches a point of 65 percent input (Transfer Set Point - adjustable). Upon a reduced heating demand, the lead boiler shall decrease input to match building load. Upon a continued heating demand, the lead boiler shall be held at the Transfer set point for a delayed time of 10 minutes (adj.), at which point the boiler controller shall prepare to start the next boiler by decreasing the input on the first boiler to minimum firing rate. At this point, the next boiler shall enable to minimum firing rate. All firing boilers inputs shall continue to increase equally to increase the heating water system temperature as required by the BAS system.

l. The isolation valve associated with the lead boiler shall be open at all times. The isolation valves associated with the lag boilers shall be open for 5 minutes (adj.) prior to energizing the lag boiler, and shall remain open to 10 minutes (adj.) after boiler(s) are disabled. All isolation valves are to be fail “OPEN”.

m. Upon a reduced heating demand, with multiple boilers firing, boilers shall decrease inputs equally until all firing boilers are at minimum firing rate for a delayed time of 2 minutes (adj.) as which point the boiler controller shall disable the latest added boiler. The remaining boiler(s) shall increase or decrease inputs as required until a boiler is to be enabled or disabled based on the Transfer Points – in which case the above scenarios are to occur.

n. Boiler inputs shall be modulated down in response to the BAS in a reverse manner. Each boiler shall come off line at the transfer set-point to maximize the condensing of the boiler system, when the system utilizes condensing boilers.

o. Boilers shall automatically be alternated as the lead boiler based on equal run time hours, and season. Condensing boilers shall always be used for the lead boilers when outdoor air temperature is above 20 degrees F. (adj.).

p. Each boiler shall operate a minimum of 10 minutes (adj.) and turn off for a minimum of 5 minutes (adj.).

q. Primary pumps or variable speed heating water pumps shall run a minimum of 2 minutes (adj.) prior to enabling it’s associated boiler, and shall remain running for a minimum of 10 minutes (adj.) after the associated boiler has been disabled.

r. If the lead boiler fails to start when energized by the BAS system, a lag boiler shall start. At this time an alarm shall be initiated through the BAS system.

s. The lead heating water pump, either primary or variable speed heating water pump) shall run continuously.

t. A variable frequency controller for each heating pump, either secondary or variable speed heating water pump, shall vary pump speed in response to differential pressure sensors located in the heating water system. VFC shall respond to sensor with the lowest pressure**.** Upon enable, the lead pump will start and be proven by the pump differential switch. The DDC Controller will monitor differential pressure between the heating water supply and return lines in locations as denoted on the Drawings. The DDC Controller will increase or decrease the pump speed to maintain the desired set-point at the lowest pressure point. Upon lead pump obtaining 100 percent speed for 10 minutes (adj.), the lag pump will start. The DDC Controller will increase or decrease the pump speeds so that each pump is providing 50 percent of the system flow. Should the pumps fall below 50 percent speed for a minimum of 10 minutes (adj.), the lag pump will turn off and the lead pump speed will be controlled to maintain set-point.

u. Provide temperature sensors, differential pressure sensors, flow meter, wiring and programming of all devices to the BAS system. Coordinate with other trades for proper balancing and start-up of system. Coordinate boiler controller interface with boiler manufacturer.

v. The Building Automation System shall automatically start/stop and alternate pumps with the “off” pump as a backup, should the lead pump fail.

w. The minimum speed for the heating water pumps shall be as required to maintain the minimum flow rate through the boilers as required by the unit manufacturer, or the minimum flow rate recommended by the pump manufacturer, whichever flow rate is larger. The rate of speed change on the heating water pumps shall not exceed the requirements of the boiler manufacturer. Contractor shall be responsible to provide additional bypass if the boiler purchased can’t meet the minimum water flows listed in the schedule.

x. Condensing boilers or small boilers only shall be energized along with heating water pumps shall be enabled any time that any of the systems are in dehumidification mode.

y. Boiler plant and hot water pumps are to be monitored for dehumidification mode. The BAS shall generate an alarm and not permit the units to enter the dehumidification mode because it detects that the Hot Water System is not enabled, or in alarm, and cannot provide the reheat necessary for dehumidification. A visible graphic to be displayed on the BAS.

z. Upon alarm of all boilers in the heating plant, with the outside air temperature above 50 degrees F and the chillers energized, the hot water pumps are to be commanded “OFF” to prevent the heating water from extracting cooling at the reheat coils.

J. Electric Cabinet Unit Heaters

1. An electronic low voltage adjustable temperature sensor/controller shall enable the unit fan and electric heating coil on a call for heating. BAS system shall have controls graphic.

K. Electric Propeller Unit Heaters

1. An electronic low voltage adjustable temperature sensor/controller shall enable the unit fan and electric heating coil on a call for heating. BAS system shall have controls graphic.

L. Exhaust Fans

1. General exhaust fans serving toilet rooms, storage rooms, etc. as scheduled shall operate based on time of day schedule with associated temperature control zones.

2. Exhaust fans in spaces with heat producing equipment such as kilns, transformers, technology equipment, etc. as scheduled shall be energized on a rise in room temperature above 85 degrees F. (adj.) as determined by a wall mounted, reverse acting thermostat. Fans with line voltage temperature sensors shall include status monitoring.
3. Exhaust fans servicing custodial closets and other areas requiring continuous fume or odor control as scheduled shall run continuously 24 hours per day.
4. Exhaust fans providing temporary fume or odor control such as science or art room general exhaust, or are associated with kitchen hoods, dishwasher hoods, fume hoods, paint booths, etc. as scheduled shall be controlled by a timer switch. Fans shall include status monitoring.
5. See Exhaust Fan Schedules on the Drawings.
6. A motor current operated switch shall input fan status to a DDC panel for all exhaust fans.

M. Mini-Split Systems
1. The Contractor shall mount and wire thermostat provided by unit manufacturer. Control sequence shall be part of unit mounted controls. Provide interconnecting wiring between indoor unit and outdoor unit. Monitor room temperature through the central BAS panel and alarm if room temperature rises above 85F (adj.) degrees.

N. Building Relief
1. Provide a wall mounted static pressure sensor in each zone. Relief air control dampers shall modulate open as required to maintain a slight positive pressure in the building. Refer to contract documents for quantity and locations of relief dampers in each zone. The BAS shall generate an alarm if building zone is reading negative pressure for 30 min. (adj.). Initial set-point to be 0.05” WC to open relief air dampers.

O. Variable Frequency Controller.
1. The Building Automation System shall monitor alarms and outputs from the VFC, via BACnet Communication Interface.

P. Boiler Room Emergency Shut-Down
1. Provide an emergency shut-down button switch in the boiler room to shut-down all gas-fired equipment upon activation.
2. Emergency shut-down button switch shall be located near the door in the path of egress from the boiler room.
3. Activation of the emergency shut-down switch shall send an alarm to the building automation system.
4. Coordinate shutdown of power to boilers with electrical contractor.

Q. Smoke Detection
1. Contractor shall wire between smoke detector and unit to shut-down unit on smoke detection.

R. Carbon Dioxide Sensor
1. Install carbon dioxide sensor(s) as shown on the drawings and/or as required by the sequence of operations.
2. Install outside carbon dioxide sensor.
3. Carbon dioxide levels shall be monitored through the building automation system.

S. Humidity Sensor
1. Install humidity sensor as shown on the drawings and/or as required by the sequence of operations.

T. Fire Alarm
1. Coordinate with Division 26 Electrical Contractor and provide necessary contacts to shut down all mechanical equipment during a fire alarm. The system shall be capable of restarting equipment globally upon a “no alarm signal” from the fire alarm panel.

U. Unoccupied Set-point

1. The Building Automation System shall be setup to allow a global change to unoccupied mode set-points from the temperature control system.

V. Emergency Shutdown

1. The Building Automation System shall shutdown all mechanical equipment. Shutdown shall be located on the Temperature Control System graphic home page and shutdown key switch to be located at each building. Coordinate shutdown key switch location with school district representative.

W. Day/Night Zones

1. The following shall be the accepted zone control. Zone control shall include all air handling units, power terminal units, unit ventilators, fan coil units, blower coil units, variable-volume terminals, and exhaust fans. All zones to include capabilities through the direct digital controller for override setting to full occupied cycle during unoccupied cycle.
2. Zones: Refer to drawings for temperature control zone information. Each temperature control zone shall be included with independent schedules.

X. Critical Alarms

1. Critical alarms shall dial or send text to personal cell telephones, personal home telephones, and send email messages to school district employees as determined by the school corporation. Alarms shall be setup and active prior to building occupancy. The following will be considered critical alarms:
   a. Any boiler alarm.
   b. Any air handling unit manual low-limit or freeze-stat alarm,
   c. Any air handling unit fan failure and/or heat wheel motor failure.
   d. Any packaged rooftop unit alarm.
   e. Any circulation pump failure
   f. Any space temperature dropping below 45 degrees F. (adj.) or rising above 85 degree F (adj.).
   g. Any technology room temperature above 85 degrees F.
   h. Any other alarm deemed critical by the school corporation and/or Architect/Engineer.
   i. Refer to all sequences of operation for additional alarms.

END OF SECTION 23 09 93

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Hot-water heating piping.
   2. Condensate-drain piping.
   3. Air-vent piping.
   4. Air control devices

B. Related Sections include the following:
   1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.2 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
   1. Hot-Water Heating Piping: 125 psig at 200 deg F.
   2. Condensate-Drain Piping: 150 deg F.
   3. Air-Vent Piping: 200 deg F.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
   2. Air control devices.
   3. Chemical treatment.
   4. Hydronic specialties.
   5. Grooved fittings and joint couplings, provide applicable styles used.

1.4 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped or identified for quality assurance and traceability.

E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.6 EXTRA MATERIALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Grooved-Copper Fittings option: ASME B16.22.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Tyco-Grinnell
b. Anvil Gruvlok.
c. Victaulic Company of America.
2. Grooved-End Copper Fittings: ASME B16.22 wrought copper and ASTM B 75, copper tube or ASME B16.18 and ASTM B 584, bronze casting, manufactured to copper tube dimensions. Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.
3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EHP gasket rated for maximum 250 deg F for use with housing, and electroplated steel bolts and nuts.

D. Copper or Bronze Pressure-Seal Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Stadler-Viega (Propress)
b. Nibco
c. Elkhart
2. Housing: Copper.
3. O-Rings and Pipe Stops: EPDM.
4. Tools: Manufacturer's special tools.
5. Minimum 200-psig working-pressure rating at 250 deg F.

E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. T-DRILL Industries Inc.

F. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   1. Material Group: 1.1.
   2. End Connections: Butt welding.
   3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Tyco-Grinnell.
      b. Anvil Gruvlok.
      c. Victaulic Company of America.
   2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   3. Couplings: Rigid pattern, unless otherwise indicated, ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
      a. NPS 2 through NPS 12:
         1) Rigid Type: Housings shall be cast with bolt pads to provide rigidity and system support and haning in accordance with ANSI B31.1 and B31.9.
            a) NPS 2 through NPS 6: Installation-Ready, for direct stab installation without field disassembly, with grade EHP gasket rated to +230 deg. F.
            b) Zero-Flex Style.

2) Flexible Type: For use in locations where vibration attenuation and stress relief air required. Three flexible couplings may be used in lieu of a flexible connector. The couplings shall be placed in close proximity to the source of the vibration.
3) Flange Adapter: Flat face, ductile iron housings with elastomer pressure responsive gasket, for direct connection to ANSI Class 125 or 150 flanged components.

b. 14 inch through 24 inch with lead-in chamfer on housing key and wide width FlushSeal® gasket.
1) Rigid Type: Housing key shall fill the wedge shaped AGS groove and provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.
2) Flexible Type: Housing key shall fit into the wedge shaped AGS groove and allow for linear and angular pipe movement.
3) Flange Adapter: Flat face, ductile iron housings with elastomer pressure responsive gasket, for direct connection to ANSI Class 125 or 150 flanged components.

I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PVC PIPE AND FITTINGS

A. PVC Material: The material used in the manufacture of the pipe shall be a rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784. This compound shall be light gray in color.

B. Pipe Dimensions: All sizes of PVC Schedule 80 pipe shall be manufactured by and ISO 9001 certified manufacture in strict accordance to the requirements of ASTM D1785 for physical dimensions and tolerances. Each production run of pipe manufactured in compliance to the standard, shall also meet or exceed the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM D1785.

C. Pipe Markings: Product marking shall meet the requirements of ASTM D1785 and shall include: the manufacturer's name (or the manufacturer's trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in PSI for water @ 73°F; the ASTM designation D1785.

D. Threaded metal to plastic connections are not permitted. Where transitions between plastic and metal pipe and fittings occur, compression style metal to plastic unions, flanges, or grooved connections shall be utilized.

E. Grooved Mechanical-Joint Fittings and Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Tyco-Grinnell.
b. Anvil Gruvlok.
c. Victaulic Company of America.
2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

3. Couplings: Rigid pattern, unless otherwise indicated, ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
    a. NPS 2 through NPS 12:
        1) Flexible Type: For use in locations where vibration attenuation and stress relief air required. Three flexible couplings may be used in lieu of a flexible connector. The couplings shall be placed in close proximity to the source of the vibration.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Grooved Joint Lubricants: Lubricate gaskets in accordance with the manufacturer's recommendations with lubricant supplied by the coupling manufacturer that is suitable for the gasket elastomer and system media.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

H. PVC solvent Joints: Solvent-cemented joints should be utilized in a two step process with primer manufactured for thermoplastic piping systems conforming to ASTM F656 and solvent cement conforming to ASTM 2564. Primer shall be clear. Solvent-cement shall be clear, medium-bodied and medium-setting and formulated for PVC piping.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Hart Industries International, Inc.
    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Capitol Manufacturing Company.
      b. Central Plastics Company.
      c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
   2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Calpico, Inc.
      b. Lochinvar Corporation.
   2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Tyco-Grinnell
      b. Anvil Gruvlok
      c. Perfection Corporation; a subsidiary of American Meter Company.
      d. Precision Plumbing Products, Inc.
      e. Sioux Chief Manufacturing Company, Inc.
      f. Victaulic Company of America.
   2. Electroplated steel nipple or ductile iron casing with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.6 VALVES

A. Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong Pumps, Inc.
      b. Bell & Gossett Domestic Pump; a division of ITT Industries.
      c. Taco.
      d. Tyco-Grinnell.
      e. Victaulic Company
   2. Body: Bronze or a metal copper alloy, ball, globe, or plug type with calibrated orifice or venturi.

3. Ball: Brass or stainless steel.
4. Disc: A metal copper-alloy.
5. Plug: Resin.
6. Seat: PTFE or EPDM.
7. End Connections: Threaded or socket.
8. Pressure Gauge Connections: Integral seals for portable differential pressure meter.
9. Handle Style:
   a. Lever, with memory stop to retain set position.
   b. Hand wheel, with memory stop to retain set position.
10. CWP Rating: Minimum 300 psig.
11. Maximum Operating Temperature: 230 deg F.
12. Valve shall be selected between 2 and 6 feet water pressure drop. Verify optimal sizing with manufacturer.

Diaphragm-Operated, Pressure-Reducing Valves:

13. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Amtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump; a division of ITT Industries.
    d. Spence Engineering Company, Inc.
    e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
14. Body: Bronze or brass.
15. Disc: Glass and carbon-filled PTFE.
16. Seat: Brass.
17. Stem Seals: EPDM O-rings.
18. Diaphragm: EPT.
19. Low inlet-pressure check valve.
20. Inlet Strainer: removable without system shutdown.
21. Valve Seat and Stem: Noncorrosive.
22. Sized for a maximum operating temperature 225 degrees F.
23. Sized for a maximum operating pressure of 125 psig.
24. Valve Size and Capacity: Selected to suit system in which installed. Refer to detail in Contract Documents.
25. Operating Pressure: Inlet pressure up to 300 psig. Outlet pressure field adjustable from 10 to 35 psig.

D. Diaphragm-Operated Safety Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amtrol, Inc.
      b. Armstrong Pumps, Inc.
      c. Bell & Gossett Domestic Pump; a division of ITT Industries.
      d. Spence Engineering Company, Inc.
      e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Body: Bronze or brass.
   3. Disc: Glass and carbon-filled PTFE.
   4. Seat: Brass.
   5. Stem Seals: EPDM O-rings.
   6. Diaphragm: EPT.
   7. Wetted, Internal Work Parts: Brass and rubber.
   8. Inlet Strainer: removable without system shutdown.
   9. Valve Seat and Stem: Noncorrosive.
   10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

E. Automatic Flow-Control Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bell & Gossett Domestic Pump; a Division of ITT Industries.

b. Flow Design Inc.
c. Nexus
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 200 deg F.
10. Valve size to be selected between 2 and 6 feet water pressure drop (WPD). Verify optimal sizing to minimize pressure drop with unit manufacturer.
11. Removable flow cartridge.

2.7 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.
5. Wessels.

B. Manual Air Vents:
1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:
1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

2.8 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
1. Body: ASTM A 536, Grade 65-45-12, ductile iron with coupled cover or ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; grooved or flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40 or 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent total free area.
4. CWP Rating: 300 psig.
5. Include blow down valve with cap and chain.

B. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.

3. Strainer Screen: 40 or 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.
5. Include blow down valve with cap and chain.

C. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap or factory fabricated steel body with T-bolt hinged closure for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40 or 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.
5. Include blow down valve with cap and chain.

D. Stainless-Steel Bellow, Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.
6. Three flexible style couplings may be used in lieu of flexible connectors for vibration attenuation and stress relief for services to 230 deg. F. The couplings shall be placed in close proximity to the source of the vibration.

E. Spherical, Rubber, Flexible Connectors:
1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.
6. Three flexible style couplings may be used in lieu of flexible connectors for vibration attenuation and stress relief for services to 230 deg. F. The couplings shall be placed in close proximity to the source of the vibration.

F. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.
2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure seal joints.
2. Type L, drawn-temper copper tubing, grooved, mechanical joint coupling and fittings, and grooved mechanical joints.
3. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

4. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Condensate-Drain Piping:
1. Within non-plenum rated buildings areas:
a. Schedule 80 PVC pipe with solvent-cement joints and/or grooved, flanged or threaded fittings connections. Pipe shall not bear the weight of installed equipment and flow control devices. Where pipe connections are used to bear the weight of equipment, equipment shall be independently supported, and if necessary copper or stainless spool pieces utilized to perform this function.
b. Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Within plenum rated buildings areas:
a. Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Air-Vent Piping:
1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

E. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Heating Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main as denoted on Drawings.

C. Install calibrated-orifice, balancing valves or automatic flow control valves in the return pipe of each heating or cooling terminal as denoted on Drawings.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

G. Insulation: Where insulation is indicated, install extended stem valves arranged in a proper manner to receive insulation.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap and chain, at low points in piping system mains and elsewhere as required for system drainage.

M. Reduce pipe sizes using eccentric reducer fitting installed with level side up for horizontal piping.

N. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

O. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

P. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
   1. Unions or flanges are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as unions and disconnect points).

Q. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2. All strainers shall contain blow down valve.

R. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
   1. For water systems, use adequate numbers of flexible style couplings in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with coupler manufacturer instructions and as approved by the engineer.) Where expansion loops are required, use flexible style couplings on the loops.

S. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

T. Freeze Protection
   1. Do not install any hydronic piping which includes domestic cold and hot water, fire and sprinkler water, chilled water, heating water, condenser water piping, etc. within 12 feet of an exterior wall or roof opening utilized for fresh air intake or building relief air.
   2. Any piping installed closer than 12 feet of an exterior wall or roof opening shall be moved or rerouted around the perimeter of the opening in order to prevent possible freezing of hydronic piping.

U. Install dielectric fittings as specified between connections of all dissimilar metals.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Pipe attachments shall be located adjacent to fittings at each offset or change in direction, at ends of branches over 5 feet long, at riser pipes, and along piping where necessary to prevent sags, bends, or vibration. Piping risers shall be supported at each floor level.

D. Hanger rod must hang perpendicular before and after pipe covering or insulation is applied.
   1. Support piping from rolled steel beams or channels from any point on either top or bottom flanges.
   2. Support piping from open web steel joists from hangers connected to either top or bottom chords within 3 inches of center of chord panel points (intersection of diagonal or vertical chord with top or bottom chord). Joist reinforcement will be required if hangers are not installed at panel points. Refer to structural details.
   3. In addition to maximum spacing of hangers or supports specified below, the number and spacing of hangers and supports shall be such as to equally distribute loads to all structural members in the system.
   4. Connections to structural members shall be clamping devices which do not damage or deform structural elements. Welding to or drilling holes in structural members is not permitted unless specifically approved by Architect.
   5. Threaded rod shall not be bent. Provide swivel connection or other means to prevent stress on threaded rod.

E. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
   2. Adjustable roller hangers for individual horizontal piping 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

F. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
   2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
   3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
   6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
   7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
   8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
   9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
   10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
   11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
   12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
   13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.

14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

G. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

H. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

I. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads, which permit support and hanging in accordance with ANSI B31.1, B31.3, and B31.9.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
1. Grooved joints shall be installed in accordance with the manufacturer’s latest published installation instructions.
2. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
3. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer.
4. The grooved coupling manufacturer’s factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools and installation of grooved joint products.

a. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training of jobsite visit(s).)

J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

K. Pressure-Sealed Joints: Use manufacturer-recommended PFT series tool and procedure. Leave insertion marks on pipe after assembly.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gauges and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gauges for HVAC Piping."

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens. All piping in the entire building is to be flushed, regardless of installation method.
    a. Clean water shall be water that has been through the permanent project softener and permanent project domestic water filtration, or from an approved public water supply, by A/E.
    b. All rooms, branch piping, and equipment will be isolated prior to initiating flush/clean/fill.
    c. The main piping will be filled with clean water and mild cleaning agents.
    d. A water quality sample will be taken by the chemical treatment company.
    e. The drain valve(s) at the end of each pipe run will be opened, with a hose routed outside the building.
    f. Utilizing the main circulating pumps, this water will be re-circulated for a minimum of 48 hours.
    g. After initial flush, this water will be removed and the process repeated until water sample is deemed acceptable by F/H and CxA.
    h. Once the main piping is approved clean, the drain valves to each room or branch will be opened individually until clean water is flowing from the drain valve.
    i. The individual strainers will be removed, cleaned, and reinstalled. Multiple strainer cleanings may be required during the flush/clean/fill procedure.
    j. At that point, the isolation valves to each room will be opened and the total system will be filled.
    k. Utilizing the main circulating pumps, this water will be re-circulated for a minimum of 48 hours.

l. The drain valves to each room or branch will be opened individually until clean water is flowing from the drain valve.
m. The individual strainers will be removed, cleaned, and reinstalled. Multiple strainer cleanings may be required during the flush/clean/fill procedure.
n. The process is to be repeated until water sample is deemed acceptable by F/H and/or CxA.

4. Isolate all equipment and all equipment coils from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
6. Corrosion inhibitor to be applied after flushing and before filling the piping system.

B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:
1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

3.9 PREPARATION AND CLEANING PROCEDURES

A. Preparation
1. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
2. Place terminal control valves in open position during cleaning.

B. Cleaning Sequence
1. Add cleaner to closed systems at concentration recommended by manufacturer. Hot Water Heating Systems: Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water. Circulate for 6 hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed.
2. Use neutralizer agents on recommendation of system cleaner supplier and approval of A/E.
3. Remove, clean, and replace strainer screens.
4. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

C. Refer to Division 23 Section 232500 – HVAC Water Treatment for additional requirements.

END OF SECTION 23 21 13

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Division 23 Section “Common Motor Requirements for HVAC Equipment”.
   1. All motors energized by a variable frequency controller shall include a maintenance free, circumferential, conductive microfiber shaft grounding ring to discharge shaft currents to ground.

B. Refer to Division 26 Section “General Electrical Requirements”.

1.2 SUMMARY

A. This Section includes the following:
   1. Close-coupled, in-line centrifugal pumps.
   2. Pump specialty fittings.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

1.5 CLOSEOUT SUBMITTALS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals.
   1. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

E. Each pump shall be provided with premium efficient motors.

F. Impellers shall be sized for a maximum diameter not to exceed 85 percent of the pumps largest diameter.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 EXTRA MATERIALS AND TRIMMING

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Mechanical Seals: One mechanical seal(s) for each pump.
   2. Provide services to trim each pump impeller to specific performance characteristics as specified.

1.10 WARRANTY

A. Manufacturer’s standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong Pumps Inc.
   2. Bell & Gossett; Div. of ITT Industries.
   3. Grundfos Pumps Corporation.
   4. Patterson Pump Co.; a Subsidiary of The Gorman-Rupp Co.
   5. Taco, Inc.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction:
   1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gauge tappings at inlet and outlet, and threaded companion-flange connections.
   2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
   3. Pump Shaft: Stainless steel.

4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Oil lubricated; bronze-journal or thrust type.

D. NEMA Premium Efficient Motor: Single speed, with permanently lubricated or grease-lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Motor shall be nonoverloading throughout the entire pump curved. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.2 PUMP SPECIALTY FITTINGS

A. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gauge ports with integral check valve, and orifice for flow measurement.

B. All pump fittings to be provided by the same manufacturer as the pump.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4 and HI 2.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Vibration isolation devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

E. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Vibration isolation devices are specified in Division 21 Section "Vibration Controls for HVAC Piping and Equipment." Hanger and support materials are specified in Division 22 Section “Hangers and Supports for HVAC Piping and Equipment."

F. Provide services to trim pump impellers for specific performance requirements as specified.

3.3 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation or HI 2.1-2.5, "Vertical Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check valve and balancing or triple-duty valve on discharge side of pumps.

F. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gauges on pump suction and discharge, at integral pressure-gauge tapping. Install single gauge with multiple input selector valve.

I. Install check valve and ball valve on each condensate pump unit discharge.

J. Install electrical connections for power, controls, and devices.

K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.

b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 21 23

SECTION 23 25 00 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following HVAC water-treatment systems:
   1. Chemical treatment test equipment.
   2. HVAC water-treatment chemicals.

1.2 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. TDS: Total dissolved solids.

1.3 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
   1. Chemical Solution
   2. Chemical test equipment

1.5 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 CHEMICALS

A. Chemicals:
   1. Solid Blend – BlendCor SN for closed loop treatment

2.2 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer recommended equipment and chemicals in a wall mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Common Work Results for HVAC."

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

B. Remove and replace malfunctioning units and retest as specified above.

C. At eight-week intervals following Substantial Completion and during the 1 year warranty period, perform separate water analyses on hydronic systems to show that the system is maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

D. Comply with ASTM D 3370 and with the following standards:
1. Silica: ASTM D 859.
2. Steam System: ASTM D 1066.
3. Acidity and Alkalinity: ASTM D 1067.
4. Iron: ASTM D 1068.
5. Water Hardness: ASTM D 1126.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 25 00

SECTION 23 29 23 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes solid-state, PWM, VFCs for speed control of three-phase, squirrel-cage induction motors.

1.2 DEFINITIONS

A. ASHRAE: American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

B. BMS: Building management system.

C. IGBT: Integrated gate bipolar transistor.

D. LAN: Local area network.

E. PID: Control action, proportional plus integral plus derivative.

F. PWM: Pulse-width modulated.

G. VFC: Variable frequency controller.

H. VFD: Same as VFC.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of VFC. Include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. Shop Drawings: For each VFC.
   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Each installed unit's type and details.
      b. Nameplate legends.
      c. Short-circuit current rating of integrated unit.
   2. Wiring Diagrams: Power, signal, and control wiring for VFCs. Provide schematic wiring diagram for each type of VFC.

C. Qualification Data: For manufacturer.

1.4 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
      a. Routine maintenance requirements for VFCs and all installed components.

b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, minimum clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store VFCs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFCs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
1. Ambient Temperature: 0 to 40 deg C.
2. Humidity: Less than 90 percent (noncondensing).
3. Altitude: Not exceeding 3300 feet.

B. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.
2. Indicate method of providing temporary electrical service.
3. Do not proceed with interruption of electrical service without Construction Manager's written permission.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.8 COORDINATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

C. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
   2. Eaton Corporation; Cutler-Hammer products.
   3. Schneider Electric; Square D products.
   4. Yaskawa Electric America, Inc.; Drives Division.

B. Products of other manufacturers will be considered for acceptance only when allowed in Section 260050, General Electrical Requirements.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
   1. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

D. Unit Operating Requirements:
   1. Input ac voltage tolerance of 208 V, plus or minus 10 percent.
   2. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
   3. Input frequency tolerance of 60 Hz, plus or minus 6 percent.
   4. Minimum Efficiency: 96 percent at 60 Hz, full load.
   5. Minimum Displacement Primary-Side Power Factor: 96 percent.
   6. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
   7. Starting Torque: 100 percent of rated torque or as indicated.
   8. Speed Regulation: Plus or minus 1 percent.

E. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
   1. Electrical Signal: 4 to 20 mA at 24 V.

F. Internal Adjustability Capabilities:
   1. Minimum Speed: 5 to 25 percent of maximum rpm.
   2. Maximum Speed: 80 to 100 percent of maximum rpm.
   3. Acceleration: 2 to a minimum of 22 seconds.
   4. Deceleration: 2 to a minimum of 22 seconds.
   5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

G. Self-Protection and Reliability Features:
   1. Input transient protection by means of surge suppressors.
   2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
   3. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class 20 performance.
   4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
   5. Instantaneous line-to-line and line-to-ground overcurrent trips.
   6. Loss-of-phase protection.
   7. Reverse-phase protection.
   8. Short-circuit protection.
   9. Motor overtemperature fault.

H. Asingle VFC serving multiple motors:
   1. Include motor overload protection as required per NEC 430 126(B). This shall provide individual protection to each motor preventing overheating/overcurrent. The motor protection panel shall be wired between the VFC and each motor. Wiring to be completed by the electrical contractor.
   2. The VFC and motor overload panel shall be sized to meet the total amperage size of all the motors.

I. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

J. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

K. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

L. Input Line Conditioning: DC bus link reactors, 5 percent impedance.

M. VFC Output Filtering: Output line reactors, 5 percent impedance.

N. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
   1. Power on.
   2. Run.
   3. Overvoltage.
   4. Line fault.
   5. Overcurrent.
   6. External fault.

O. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control and elapsed time meter.

P. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
   1. Output frequency (Hz).
   2. Motor speed (rpm).
   3. Motor status (running, stop, fault).
   4. Motor current (amperes).
   5. Motor torque (percent).
   6. Fault or alarming status (code).
   7. PID feedback signal (percent).
   8. DC-link voltage (VDC).
   9. Set-point frequency (Hz).
   10. Motor output voltage (V).

Q. Control Signal Interface:
   1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
   2. Pneumatic Input Signal Interface: 3 to 15 psig.
   3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
      a. 0 to 10-V dc.
      b. 0-20 or 4-20 mA.
      c. Potentiometer using up/down digital inputs.
      d. Fixed frequencies using digital inputs.
      e. RS485.
      f. Keypad display for local hand operation.
   4. Output Signal Interface:
      a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
         1) Output frequency (Hz).
         2) Output current (load).
         3) DC-link voltage (VDC).
         4) Motor torque (percent).
         5) Motor speed (rpm).
         6) Set-point frequency (Hz).
   5. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
      a. Motor running.
      b. Set-point speed reached.
      c. Fault and warning indication (overtemperature or overcurrent).
      d. PID high- or low-speed limits reached.

R. Communications: Provide an RS485 interface allowing VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory. Coordinate protocol with BMS installer. Comply with the following BMS protocols:
   1. ASHRAE; BACnet.
   2. Echelon Corporation; LONWORKS networks, LONTALK protocol, LONMARK compliant.
   3. Johnson Controls, Inc.; Metasys BMS, N2.
   4. Schneider Electric; Modicon, Modbus RTU.
   5. Automated Logic; WebCTRL

S. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.

T. Remote Indication Circuit Terminals: Mode selection, controller status, and controller fault.

2.3 ENCLOSURES

A. Description: NEMA 250, Type 1, unless otherwise indicated.

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Standard Displays:
1. Output frequency (Hz).
2. Set-point frequency (Hz).
3. Motor current (amperes).
4. DC-link voltage (VDC).
5. Motor torque (percent).
6. Motor speed (rpm).
7. Motor output voltage (V).

E. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Comply with NECA 230.

B. Install wall-mounted VFCs to steel slotted support system specified in Division 26 Section "Hangers and Supports for Electrical Systems."

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices.
   1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety function when switch is in hand position.
   2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
   1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
   3. Report results in writing.

C. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 29 23

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg. Metal ducts include the following:
   1. Rectangular ducts and fittings.
   2. Single-wall, round, spiral-seam ducts and formed fittings.
   3. Double-wall, round, spiral-seam ducts and formed fittings.
   4. Duct liner.
   5. Phenolic-Prefabricated cladded and lined metal duct

B. Related Sections include the following:
   1. Division 07 Section "Penetration Firestopping."
   2. Division 09 Section "Interior Painting."
   3. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by A/E. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Drawn to 1/4 inch equals 1 foot scale. Show fabrication and installation details for metal ducts.
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Duct layout indicating sizes and pressure classes.
   3. Elevations of top and bottom of ducts.
   4. Dimensions of main duct runs from building grid lines.
   5. Fittings.
   6. Reinforcement and spacing.
   7. Seam and joint construction.
   8. Penetrations through fire-rated and other partitions.
   9. Equipment installation based on equipment being used on Project.
   10. Duct accessories, including access doors and panels.
   11. Hangers and supports, including methods for duct and building attachment, vibration isolation.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Other systems installed in same space as ducts.
   3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
   4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

5. In general, the piping and ductwork shown on the drawings shall be considered as diagrammatic for clearness in indicating the general run and connections required, and may not be shown in its true position. The piping and ductwork equipment may have to be offset, lowered, or raised as required to accommodate field conditions.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports, AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members, and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 – Systems and Equipment" and Section 7 – "Construction and System Start-up."

E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 – "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Carbon-Steel Sheets: ASTM A 366, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

D. Stainless Steel: ASTM A480, Type 304 and having a No. 20 finish for concealed ducts, and a finish to match kitchen or dishwasher hoods for exposed ducts.

E. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 DUCT LINER

A. Rectangular and Round duct Liner:
1. Flexible Elastomeric: Closed-cell, sponge or expanded-rubber materials. Microban® antimicrobial inhibitor. Comply with ASTM C 534, Type I for tubular materials and type II for sheet materials. ASTM E84 at 25/50 for 1" thick.
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Aeroflex USA Inc.; Aeroflex Breathe-EZ
   b. Armacell LLC; AP/Armaflex Duct Liner
   c. K-Flex USA; InsK-Flex Duct Liner
3. Materials: Comply with ASTM C534.
   a. Thickness: 1 inch; increase thickness as necessary to meet or exceed all below indicated sound absorption coefficient values.
   b. Thermal Conductivity (K-Value): 0.26 at 75 degrees F. mean temperature.
   c. Water Permeability / Absorption: 0.05 Perm-Inch / 0.2% by volume.
   d. Minimum/Maximum Use Temperatures: -290°F / 180°F.
   e. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
   f. Sound Absorption Coefficients at Frequency:

125 Hz	250 HZ	500 HZ	1K Hz	2K Hz	4K Hz	NCR†
0.08	0.22	1.03	1.37	0.37	0.50	0.06

      1) Increase liner thickness, as necessary, to meet or exceed all values.

2.4 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
1. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' *Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers*.

B. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

C. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

A. Hanger Materials: Galvanized sheet steel or threaded steel rod.
   1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
   2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
   3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

C. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
   1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
   2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
   3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

D. Contractor may use load rated cable suspension system. Suspension system shall have a specified manufacturers safe working load and supplemental safety factor of at least five times the safe working load.
   1. Suspension system shall be verified by SMACNA Testing and Research Institute to be in compliance with SMACNA Duct Construction Standards Guidelines (1995 CH.4).

2.6 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
   1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
   2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
   1. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
   2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.7 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. The net free area of the duct dimensions on the Contract Documents shall be maintained. Increase metal duct dimensions as necessary to compensate for addition of the liner.

B. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

C. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

D. Butt transverse joints without gaps and coat joint with adhesive.

E. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

F. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

G. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm

H. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

I. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   1. Fan discharges.
   2. Intervals of lined duct preceding unlined duct.
   3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

J. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.8 ROUND DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Duct Joints:
   1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
   2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
   3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
   4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
      a. Manufacturers:
         1) Ductmate Industries, Inc.
         2) Lindab Inc.

D. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

E. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

F. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
   1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
   2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
      a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
      b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
      c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
      d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
   3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
      a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
      b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
      c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
      d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
   4. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
   5. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
   6. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
   7. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
   8. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
   9. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
   10. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

2.9 DOUBLE-WALL DUCT AND FITTING FABRICATION

A. Manufacturers:
   1. Lindab Inc.
   2. McGill AirFlow Corporation.
   3. SEMCO Incorporated.

B. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.
   1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.
   2. Insulation: 1-inch thick fibrous glass, unless otherwise indicated. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.
      a. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
   3. Solid Outer Ducts: Use the following sheet metal thicknesses and seam construction:
      a. Ducts 3 to 8 Inches in Diameter: 0.019 inch with standard spiral-seam construction.

b. Ducts 9 to 42 Inches in Diameter: 0.019 inch with single-rib spiral-seam construction.
c. Ducts 44 to 60 Inches in Diameter: 0.022 inch with single-rib spiral-seam construction.
d. Ducts 62 to 88 Inches in Diameter: 0.034 inch with standard spiral-seam construction.

4. Perforated Inner Ducts: Fabricate with 0.028-inch thick sheet metal having 3/32-inch diameter perforations, with overall open area of 23 percent.
5. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.

C. Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.
1. Solid Outer Ducts: Use the following sheet metal thicknesses:
a. Ducts 3 to 34 Inches in Diameter: 0.028 inch.
b. Ducts 35 to 58 Inches in Diameter: 0.034 inch.
c. Ducts 60 to 88 Inches in Diameter: 0.040 inch.
2. Perforated Inner Ducts: Fabricate with 0.028-inch thick sheet metal having 3/32-inch diameter perforations, with overall open area of 23 percent.

2.10 PHENOLIC-PREFABRICATED CLADDED AND LINED METAL DUCT

A. Manufacturers:
1. Thermaduct
2. Kingspan
3. Prorduct

B. Pre-Insulated HVAC Ductwork System: Provide for supply, return ductwork as shown on the Drawings. System shall include panels, fabrication methods, coupling systems, and accessories to provide a complete system to meet the following performance criteria:
1. Classification: UL Listed as a Class 1 Air Duct, to UL 181, NFPA 90A and NFPA 90B
2. Fire and Smoke Performance when tested in accordance with ASTM E84 or UL 723:
a. Flame Spread: <=25
b. Smoke Developed: <=50
3. Materials: CFC/HCFC free, zero Ozone Depletion Potential (ODP), fiber-free rigid thermoset phenolic insulation core faced with 1 mil low vapor permeability aluminum foil reinforced with glass scrim. Foil is branded on inside of duct and plain on the outer facing.
4. Nominal Density: 3.4 to 3.75 pcf (55 to 60 kg/m3).
5. Closed Cell Content: minimum 90 percent.
6. Compressive Strength: Minimum 25 psi (175 kPa) at 10 percent compression.
7. Air Leakage: SMACNA Air Leakage Class 3.
8. Mean Air Velocity: Maximum 5000 fpm (25.4 m/s) with all joints sealed.
9. Design Pressures: a. Positive Pressure: Maximum 4 inch w.g. (1000 Pa). b. Negative Pressure: Maximum 3 inch w.g. (750 Pa).
10. Commissioning Pressures - As designed to, max commissioning 4 inch w.g. (1000Pa.).
11. Temperature Range: Internal air temperature range -4F to 176F deg. F (-20 to 80C) during continuous operation, inside ducts or ambient surrounding temperature.
12. Thermal Resistance, Wall Thickness and R-Value: a. 7/8 inch (22 mm) thick, R 6.0 square feet per hour F/Btu (1.047 square meter K/W). b. 1-3/16 inch (30 mm) thick, R 8.1 square feet per hour F/Btu (1.428 square c. meter K/W). d. 1-25/32 inch (45mm) thick, R 12 square feet per hour F/Btu (2.15 square e. meter K/W).
13. Thermal Conductivity: at 50 to 74 deg. F (10 to 23 deg C), mean 0.146 Btu inch per square foot per hour deg. F (0.021 W/m K) per ASTM C518.
14. Typical Configuration: Rectangular.

C. FABRICATION:
1. Fabricate ductwork with panels, joints, seams, transitions, reinforcements, supports, elbows, connections, and accessories in accordance with SMACNA Phenolic Duct Construction Standards and the manufacturers' guidelines.

a. 90 degree mitered elbows shall include turning vanes.
2. Fabricate ductwork with branded foil facing consistently inside the duct system.
3. Support on roof equipment rails as recommended by manufacturers requirements.

D. FINISH:
1. UV resistant PVC cladding.
a. Color as selected by Architect/Engineer

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
1. Supply Ducts: 2-inch wg.
2. Supply Ducts (before Air Terminal Units): 3-inch wg.
3. Supply Ducts (after Air Terminal Units): 2-inch wg.
4. Return Ducts (Negative Pressure): 1-inch wg.
5. Exhaust Ducts (Negative Pressure): 2-inch wg.

B. All ducts shall be galvanized steel.

3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or

duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Penetration Firestopping."

O. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

P. Paint interiors of metal ducts, that do not have duct liner, for 24 inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

Q. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACN's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.3 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. and in compliance with ASHRAE/IESNA 90.1.
1. For pressure classes lower than 2-inch wg, seal transverse joints.

B. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

A. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Chapter 5, "Hangers and Supports," unless otherwise noted.

B. Support horizontal ductwork runs on 6 foot centers and within 24 inches of each elbow and within 48 inches of each branch intersection. Where duct weight for the 6 foot length is less than 40 pounds, support hangers may be on 8 foot centers.

C. Support vertical ducts at maximum intervals of 16 feet and at each floor.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports. Leak testing is required for all medium pressure ductwork rated with a static-pressure class that exceeds 2-inch wg. Low-pressure ductwork rated below 2-inch wg will not require pressure testing.
   1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
   3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
   4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.7 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.
   1. Create other openings to comply with duct standards.
   2. Disconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   4. Coils and related components.
   5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
   6. Supply-air ducts, dampers, actuators, and turning vanes.
   7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:
   1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
   2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
   3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
   4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
   5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
   6. Provide drainage and cleanup for wash-down procedures.

F. Cleanliness Verification:
1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

3.8 CLEANING EXISTING SYSTEMS (Existing AHU-1 only)

A. Use service openings, as required, for physical and mechanical entry and for inspection.
1. Use existing service openings where possible.
2. Create other openings to comply with duct standards.
3. Disconnect flexible ducts as needed for cleaning and inspection.
4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.
5. Remove and reinstall ceiling sections to gain access during the cleaning process.

B. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

C. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or larger) particles.
2. When venting vacuuming system to the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide operative drainage system for washdown procedures.
7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present. Apply biocidal agents according to manufacturer's written instructions after removal of surface deposits and debris.

F. Cleanliness Verification:
1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
2. Visually inspect metal ducts for contaminants.
3. Where contaminants are discovered, re-clean and reinspect ducts.

G. Gravimetric Analysis: At discretion and expense of Owner, sections of metal duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.
   1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
   2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal duct system shall be re-cleaned and re-verified.

H. Verification of Coil Cleaning: Cleaning must restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Flange connectors.
5. Turning vanes.
6. Flexible connectors.
7. Flexible ducts.
8. Duct accessory hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

C. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304.

D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a Division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Greenheck Fan Corporation.
6. Nailor Industries Inc.
7. Pottorff; a division of PCI Industries, Inc.
8. Ruskin Company.
9. SEMCO Incorporated

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 1-inch wg.

E. Frame: 0.063-inch thick extruded aluminum, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked.

I. Blade Axles:
1. Material: Aluminum.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:
1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Front of rear screens.
6. 90-degree stops.

N. Sleeve: Minimum 20-gauge thickness.

2.3 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a Division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.

5. Greenheck Fan Corporation.
6. Nailor Industries Inc.
7. Pottorff; a division of PCI Industries, Inc.
8. Ruskin Company.
9. SEMCO Incorporated

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: 0.063-inch thick extruded aluminum, with welded corners and mounting flange.

F. Blades:
1. Multiple, 0.025-inch thick, roll-formed aluminum.
2. Maximum Width: 6 inches.
3. Action: Parallel.
4. Balance: Gravity.
5. Eccentrically pivoted.

G. Blade Seals: Vinyl.

H. Blade Axles: Nonferrous metal.

I. Tie Bars and Brackets:
1. Material: Aluminum.
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Synthetic or bronze.

L. Accessories
1. Flange on intake.
2. Adjustment device to permit setting for varing differential static pressure.

2.4 MANUAL VOLUME DAMPERS

A. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. McGill AirFlow LLC.
   d. METALAIRE, Inc.
   e. Nailor Industries Inc.
   f. Pottorff; a division of PCI Industries, Inc.
   g. Ruskin Company.
   h. Greenheck Fan Corporation
2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.
4. Frames:
   a. Hat-shaped
   b. Galvanized-steel channels, 0.064 inch thick.
   c. Mitered and welded corners.
   d. Flanges or attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.

b. Parallel-blade design.
c. Stiffen damper blades for stability.
d. Galvanized, roll-formed steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:
   a. Oil-impregnated bronze or molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Blade Seals: Vinyl.
9. Jamb Seals: Flexible metal.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

B. Low-Leakage, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. McGill AirFlow LLC.
   d. METALAIRE, Inc.
   e. Nailor Industries Inc.
   f. Pottorff; a division of PCI Industries, Inc.
   g. Ruskin Company.
   h. Greenheck Fan Corporation
2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel-blade design.
   c. Roll-Formed Aluminum Blades: 0.10-inch thick aluminum sheet.
6. Blade Axles: Nonferrous metal.
7. Bearings:
   a. Oil-impregnated bronze or molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Blade Seals: Vinyl.
9. Jamb Seals: Cambered aluminum.
10. Tie Bars and Brackets: Aluminum.
11. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

C. Jackshaft:
1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Nexus PDQ; Division of Shilco Holdings Inc.
   3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gauge and Shape: Match connecting ductwork.

2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. METALAIRE, Inc.
   4. SEMCO Incorporated.
   5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Double wall.

2.7 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Flame Gard, Inc.
   3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon or 0.0428-inch stainless steel.

D. Fasteners: Carbon or stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. Ventfabrics, Inc.
   4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd..
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F

H. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.9 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Atco
2. Flexmaster U.S.A., Inc.
3. Hercules Industries, Inc.
4. McGill AirFlow LLC.
5. Tuttle & Bailey; A Division of Hart & Cooley, Inc.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Low Pressure Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 175 deg F.

C. Medium Pressure Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   2. Maximum Air Velocity: 4000 fpm.
   3. Temperature Range: Minus 20 to plus 210 deg F.

D. Flexible Duct Connectors:
   1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or nylon strap in sizes 3 through 18 inches, to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at discharge of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Coordinate subparagraphs below with Division 23 Section "Metal Ducts."Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install flexible connectors to connect ducts to equipment.

H. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

I. Flexible duct shall not be acceptable for use in exhaust system or negative pressure applications.

J. Connect terminal units to supply ducts with maximum 12-inch lengths of medium pressure flexible duct. Do not use flexible ducts to change directions.

K. Connect diffusers to low-pressure ducts with maximum 5 foot lengths of flexible duct clamped or strapped in place.

L. Connect flexible ducts to metal ducts with draw bands.

M. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.
   3. Inspect turning vanes for proper and secure installation.
   4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Centrifugal roof ventilators.
   2. In-line centrifugal fans.

1.2 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Roof curbs.
   7. Fan speed controllers.

B. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Roof framing and support members relative to duct penetrations.
   2. Ceiling suspension assembly members.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.4 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck.
   2. Loren Cook Company.
   3. Acme Engineering & Mfg. Corp.
   4. Aerovent; a Twin City Fan Company
   5. Carnes Company HVAC.
   6. JencoFan; Div. of Breidert Air Products.
   7. Penn Ventilation.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
   1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.
   2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

F. Accessories:
   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent. Speed controller is to be factory mounted and wired.

2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches.
3. Pitch Mounting: Manufacture curb for roof slope.

H. Finish
1. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
a. Color and Gloss: Custom color as selected by Architect.

2.2 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck.
2. Loren Cook Company.
3. Acme Engineering & Mfg. Corp.
4. Aerovent; a Twin City Fan Company
5. Carnes Company HVAC.
6. JencoFan; Div. of Breidert Air Products.
7. Penn Ventilation.

B. Description: In-line, direct or belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
5. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
6. Disconnect switch, non-fusible type, with thermal overload protection.

2.3 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support in-line units using restrained spring isolators having a static deflection of 1 inch. Vibration-devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

D. Support suspended units from structure using threaded steel rods and elastomeric hangers or spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 23 34 23

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Shutoff single-duct air terminal units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.3 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:
      a. Instructions for resetting minimum and maximum air volumes.
      b. Instructions for adjusting software set points.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.5 COORDINATION

A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 SHUTOFF SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Environmental Technologies, Inc.; Enviro-Air Div.
2. Krueger.
3. METALAIRE, Inc.; Metal Industries Inc.
4. Nailor Industries of Texas Inc.
5. Price Industries.
6. Titus.
7. Trane Co. (The); Worldwide Applied Systems Group.

B. Configuration: Volume-damper assembly inside unit casing with control components located inside a protective metal shroud.

C. Casing: 0.034-inch steel.
1. Casing Lining: 1-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive.
2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.
2. Damper Position: Normally open.

E. Damper Actuator
1. DDC electronic damper actuator for fixing air flow on terminal shall be supplied by temperature control contractor and shipped for factory installation by terminal unit manufacturer.

F. Velocity Sensor
1. For DDC control, velocity sensor shall be averaging multi-point flow cross or ring type provided as an integral part of box by terminal unit manufacturer. Control of terminal unit velocity sensor shall be by unitary controller provided by Temperature Control Contractor.

G. Attenuator Section: 0.034-inch steel sheet metal (factory provided or field fabricated).
1. Lining: 1-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive.
2. Line as a minimum the first four feet after the heating coil unless indicated otherwise on Contract Documents.

H. Multioutlet Attenuator Section: With collars of size and quantity denoted on Drawings; each with locking butterfly balancing damper.

I. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.

J. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section "Instrumentation and Control for HVAC."

K. Factory-Mounted and Wired Controls: Electrical components shall be mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
   1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
   2. Wiring Terminations: Fan, relay, and controls to terminal strip, and terminal lugs shall match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
   3. Disconnect Switch: Factory-mounted, fused type.
   4. All controls shall be mounted in a NEMA 1 enclosure.
   5. Temperature Control Contractor shall provide DDC unitary controller to terminal unit manufacturer complete with wiring diagram for factory installation by terminal unit manufacturer, at cost to the terminal unit manufacturer.
   6. All testing and calibration of control system shall be by Temperature Control Contractor.

2.2 SOURCE QUALITY CONTROL

A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

B. Verification of Performance: Rate air terminal units according to ARI 880.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air terminal units to allow service and maintenance.

C. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve or automatic flow control valve and union or flange.

D. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
   2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   1. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
   2. Verify that controls and control enclosure are accessible.
   3. Verify that control connections are complete.
   4. Verify that nameplate and identification tag are visible.
   5. Verify that controls respond to inputs as specified.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 36 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections include the following:
1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each product indicated, include the following:
1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. A model number is indicated for each product as an example of the device required.
a. Carnes.
b. Hart & Cooley, Inc.; Hart & Cooley Div.
c. Krueger.
d. METALAIRE, Inc.; Metal Industries Inc.
e. Nailor Industries of Texas Inc.
f. Price Industries.
g. Titus.
h. Tuttle & Bailey.

2.2 AIR TRANSFER GRILLES, RETURN GRILLES, AND EXHAUST GRILLES (TYPE F, G, AND H)

A. All aluminum construction.

B. 35 degree louvers spaced 1/2 inch on center.

C. One set of fixed louvers parallel to long dimension.

D. Baked white enamel or powder paint white finish for ceiling installation. Provide wall mounted and exposed duct mounted installation with primed finish for field painting.

E. Size of grille as indicated on Drawings.

F. Equivalent to Titus “355”

2.3 SQUARE PANEL CEILING DIFFUSER (Type A, B, C, D, AND E)

A. All 18 gauge steel diffuser, 24 inch by 24 inch module size, 18 inch by 18 inch face panel.

B. Round neck connection, dimension as scheduled on Drawings.

C. Solid face panel with curved back pan designed for VAV usage. Face panel shall be easily removed.

D. Back pan shall be one-piece die-formed with smooth surfaces and no corner joints.

E. Baked white enamel finished unless otherwise denoted on Drawings.

F. Provide blank-off plates to convert diffuser to 2-way or 3-way blow where indicated on Drawings.

G. Equivalent to Titus “Omni.”

2.4 SIDEWALL RETURN GRILLE (TYPE I)

A. All aluminum construction, minimum 0.032 inch thick border.

B. Single deflection fixed aluminum blades, 1/2 inch blade spacing.

C. Blades shall be at 0 deg deflection.

D. Blades shall be parallel to long dimension.

E. Surface mounted.

F. Baked enamel finish. Custom color as selected by Architect.

G. Size of grille as indicated on Drawings.

H. Equivalent to “Titus 350FL.”

2.5 HEAVY DUTY WALL RETURN GRILLE (TYPE J)

A. Frame shall be 16 gauge welded steel construction.

B. Horizontal steel blades shall be 14 gauge steel, reinforced on 6 inch centers by vertical steel support bars. Blades shall be spaced at 1/2 inch on center, with a 0 deg fixed deflection angle.

C. Grille core shall be welded to the 14 gauge frame.

D. Baked enamel finish. Custom color as selected by Architect.

E. Grille size as indicated on Drawings.

F. Equivalent to Titus “33RL.”

2.6 LINEAR SLOT DIFFUSER (TYPE L)

A. Pattern controllers shall be one piece extruded aluminum, 24 inches long maximum, positioned between spring loaded spacers. Pattern controllers shall allow the airstream to be directed straight at base of exterior wall, as well as allowing throw reduction every two feet along the entire length of the linear slot diffusers. Pattern controllers shall be field adjustable from the face of the diffuser.

B. Material shall be minimum wall thickness 0.062 extruded aluminum. Spring steel retainers shall be used under the spacers to hold the slot diffusers assembly tightly together.

C. Factory mounted plenums shall be minimum 24 gauge galvanized steel and lined inside with black matte fiberglass insulation.

D. Flanges exposed to view shall be painted to custom color as selected by architect. All other surfaces shall be painted flat.

E. Slot width, number of slots, diffuser length and inlet collar size shall be as scheduled on the Drawings.

F. Face of wall mounted with diffuser border equivalent to Titus border “Type 77”.

G. Equivalent to Titus FlowBar “FL-15-HT.”

2.7 ROUND CEILING DIFFUSER (TYPE K)

A. All steel construction, 18 gauge.

B. 360 deg discharge pattern.

C. Three round cones with round neck.

D. Size of diffuser as indicated on Drawings.

E. Custom baked enamel color as selected by Architect.

F. Equivalent to Titus “TMR.”

2.8 ALUMINUM SUPPLY REGISTER (TYPE M)

A. All aluminum construction, minimum 0.032 inch thick border.

B. Double deflection blades, 3/4 inch blade spacing.

C. Front and rear blades, individually adjustable. Blades shall have friction pivots on both ends; plastic blade pivots are not acceptable.

D. Front blades parallel to long dimension.

E. Surface mounted on exposed ductwork.

F. Baked white enamel finish.

G. Provide aluminum opposed blade balancing damper adjustable from the grille face.

H. Size of grille as indicated on

I. Drawings.Equivalent to Titus “300FL.”

2.9 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 74 13 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
   1. Direct-expansion cooling.
   2. Heat-pump refrigeration components.
   3. Hot-gas reheat.
   4. Gas furnace.
   5. Economizer outdoor- and return-air damper section.
   6. Integral, space temperature controls.
   7. Roof curbs.

1.2 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.3 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which RTUs will be attached.
   2. Roof openings
   3. Roof curbs and flashing.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Warranty:
   1. Provide full parts and labor warranty for 24 months following initial startup
   2. Special warranty specified in this Section.

1.5 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. ARI Compliance:
   1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
   2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
   3. Comply with ASHRAE/IESNA 90.1 for minimum efficiency of heating and cooling.

C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

D. UL Compliance: Comply with UL 1995.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five (5) years from date of Substantial Completion.
   2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five (5) years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fan Belts: One set for each belt-driven fan.
   2. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carrier Corporation.
   2. Daikin.
   3. Trane; American Standard Companies, Inc.
   4. Johnson Controls Inc..

2.2 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
   1. Exterior Casing Thickness: 0.052 inch thick.

C. Inner Casing Fabrication Requirements:
   1. Inside Casing: Galvanized steel, 0.034 inch thick.

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
   1. Materials: ASTM C 1071, Type I.
   2. Thickness: 1 inch.
   3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
   4. Liner Adhesive: Comply with ASTM C 916, Type I.

E. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.
   1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
   2. Drain Connections: Threaded nipple.

2.3 FANS

A. Direct-Driven Supply-Air Fans: Double width, forward curved or backward inclined, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

C. Relief-Air Fan: Forward curved or backward inclined, shaft mounted on permanently lubricated motor.

D. Fan Motor: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

E. All motors driven by a variable frequency controller shall include a maintenance free, circumferential, conductive microfiber shaft grounding ring (AEGIS-SGR) to discharge shaft currents to ground.

2.4 COILS

A. Supply-Air Refrigerant Coil:
   1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
   3. Coil Split: Interlaced.
   4. Coating.
   5. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.

B. Outdoor-Air Refrigerant Coil:
   1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.

2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

C. Hot-Gas Reheat Refrigerant Coil:
1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: [**One**] [**Two**] <**Insert number**>.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

C. Refrigeration Specialties:
1. Refrigerant Charge: R-32, or R-454b.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Pleated: Minimum 90 percent arrestance, and MERV 13.

2.7 GAS FURNACE

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners: Stainless steel with a minimum thermal efficiency of 80 percent.
1. Fuel: Natural gas.
2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.

C. Heat-Exchanger and Drain Pan: Stainless steel.

D. Venting: Gravity vented with vertical extension.

E. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve with vertical extension.

F. Safety Controls:
1. Gas Control Valve: Modulating.
2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 DAMPERS

A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper.

B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
   1. Damper Motor: Modulating with adjustable minimum position.
   2. Relief-Air Damper: Gravity actuated with bird screen and hood.

2.9 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.10 DUAL-PLY AIR-INTAKE FILTER SCREEN SYSTEM

A. Outer ply shall consist of a commercial-grade screen that has a smooth UV resistant vinyl coating over a polyester-fiber core. The inner ply shall consist of a fine mesh screen that has electrostatic properties. Both filters shall be constructed as a single filter using a 0.3 mm heavy duty, fiber reinforced vinyl outer binding wrapped around the edge on all sides to provide a 1.125” face and back binding for high strength and durability. Binding is to be sewn to the mesh using double row of double-lock stitching. Heavy duty nylon, rust proof grommets compatible with mechanicaly locking twist fasteners must be uniformly spaced around the perimeter of the outer biding and located 9/16” from center of grommet to edge of filer. Nylon twist lock fasteners with self-drilling screws must be included.

B. Filters shall be weather-resistant, mold and mildew resistant, flame-retardant, and UV-resistant.

C. Filter screens shall be cleanable without removal.

D. Dual-Ply Performance: Airflow performance shall be less than or equal to 0.006 ich w.g. at 100 fpm, 0.083 inch w.g. at 400 fpm and 0.174 inch w.g. at 600 fpm.

E. Filter screens shall be installed on the outside of outside air-intake. Coordinate with equipment manufacturer.

F. Provide equivalent to Air Solution Company.

2.11 CONTROLS

A. Control equipment and sequence of operation are specified in Division 23 Section "Instrumentation and Control for HVAC."

B. Interface Requirements for HVAC Instrumentation and Control System:
   1. Interface relay for scheduled operation.
   2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
   3. Provide BACnet compatible interface for central HVAC control workstation for the following: Communication protocol shall be coordinated with the Temperature Control Contractor.
      a. Adjusting set points.
      b. Monitoring supply fan start, stop, and operation.
      c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
      d. Monitoring occupied and unoccupied operations.

2.12 ACCESSORIES

A. Electric heater with integral thermostat maintains minimum 50 deg F temperature in gas burner compartment.

B. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

D. Coil guards of painted, galvanized-steel wire.

2.13 STRUCTURAL ROOF CURBS

A. Roof curbs with vibration isolators specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

B. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.

C. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
   1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
      a. Materials: ASTM C 1071, Type I or II.
      b. Thickness: 1-1/2 inches.
   2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      a. Liner Adhesive: Comply with ASTM C 916, Type I.
      b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
      c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
      d. Metal Counterflashing: Manufacturer’s standard, removable, fabricated of same metal and finish as equipment support. Coordinate with roofing contractor.
      e. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
      f. Fabricate pedestal curb equipment supports to minimum height of 36 inches unless otherwise indicated.
      g. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.14 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

2.15 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
   1. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection. RTU Manufacturer provided and installed.

C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

D. Unit Operating Requirements:
   1. Input ac voltage tolerance of 208 V, plus or minus 10 percent.
   2. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
   3. Input frequency tolerance of 60 Hz, plus or minus 6 percent.
   4. Minimum Efficiency: 96 percent at 60 Hz, full load.
   5. Minimum Displacement Primary-Side Power Factor: 96 percent.
   6. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
   7. Starting Torque: 100 percent of rated torque or as indicated.
   8. Speed Regulation: Plus or minus 1 percent.

E. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

F. Enclosures: NEMA 250, Type 3R, unless otherwise indicated

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." and ARI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07 Section "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

B. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain.

B. Install piping adjacent to RTUs to allow service and maintenance.
   1. Gas Piping: Comply with applicable requirements in Division 23 Section "Facility Natural-Gas Piping" Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
   1. Install ducts to termination at top of roof curb.
   2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   3. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
   4. Install return-air duct continuously through roof structure.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:
   1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   1. Inspect for visible damage to unit casing.
   2. Inspect for visible damage to furnace combustion chamber.
   3. Inspect for visible damage to compressor, coils, and fans.
   4. Inspect internal insulation.
   5. Verify that labels are clearly visible.
   6. Verify that clearances have been provided for servicing.
   7. Verify that controls are connected and operable.

8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Start unit according to manufacturer's written instructions.
    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.
17. Inspect and record performance of interlocks and protective devices; verify sequences.
18. Operate unit for an initial period as recommended or required by manufacturer.
19. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion-air temperature at inlet to combustion chamber.
    d. Measure flue-gas temperature at furnace discharge.
    e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
20. Calibrate thermostats.
21. Adjust and inspect high-temperature limits.
22. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
23. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
24. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
25. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.
26. Simulate maximum cooling demand and inspect the following:
    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
27. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
    a. High-temperature limit on gas-fired heat exchanger.
    b. Low-temperature safety operation.
    c. Filter high-pressure differential alarm.
    d. Economizer to minimum outdoor-air changeover.
    e. Relief-air fan operation.
    f. Smoke and firestat alarms.
28. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 74 13

SECTION 23 80 61 - FUME COLLECTION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall provide the labor, materials, equipment, appliances, services and transportation, and perform operations in connection with the construction and installation of the Work. Work to be as herein specified and as denoted on the accompanying Drawings.

B. This Section of the Work includes the providing of the filtration unit, including fan, air cleaners, plenums, ductwork, flexible hose, and other related items necessary to bring the fumes generated by the welding process within the OSHA Air Quality Standards at the welder's breathing zone.

C. Related Work by Others
1. Motor starter, safety disconnect switch, and starting controls shall be by Division 23 installed by Division 26.

D. Refer to the Details and Schedules on the Drawings for additional requirements.

1.2 ACTION SUBMITTALS

A. The Contractor shall submit to the Design Engineer a copy of submittal data from the manufacturer which specifies unit parameters as follows:
1. CFM
2. Horsepower
3. Blower type
4. Static pressure
5. Electrical requirements
6. Outlet velocity

B. Refer to Division 01 Section “Submittal Procedures” for submittal requirements.

1.3 QUALITY ASSURANCE

A. Air cleaning equipment shall be manufactured by a bona fide manufacturer of the type of equipment specified. The manufacturer must be able to establish his credentials and the credentials of equipment to be sold by providing proof that said equipment is presently in use and performing successfully in similar applications.

B. The manufacturer shall have a field service network to perform service and maintenance on the equipment. A factory representative shall perform field start-up of equipment.

1.4 WARRANTY

A. Warranty: The unit shall carry a 1 year parts and labor warranty following the date of Contract Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
1. MicroAir – Ambient Air Cleaner - model MC3000
2. Donaldson-Torit – Ambient Collection System - model AT-3000

3. MAXFLO Ceiling Mounted Dust Collector – model HC-3050

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the “Substitution Request Form” and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 CEILING SUSPENDED – AMBIENT AIR CLEANER – CARTRIDGE COLLECTORS

A. The collector shall be a trhough flow cartridge filter collector designed for welding exhaust systems.

B. Cabinet shall be constructed of heavy gauge steel with welded seams and shall be rated to -25” w.g.

C. The cabinet shall be finished in a durable, multi-coat liquid or powder finish that meets ASTM B117 salt spray test of 2,000 hours. The exterior shall be finished in a custom color as selected by A/E. The interior of the unit shall be primed with a durable liquid or powder primer.

D. The unit shall be provided with an air management module with multiple connections to an extended dirty air plenum. Airflow shall be directed into a dropout zone for reduced filter loading. Each dedicated duct connection shall be provided with an electronic or pneumatic actuated blast gate that shall be opened and closed based on the usage of the system as determined by the unit control panel. The blast gates shall be constructed of heavy duty aluminum or galvanized steel construction, and shall be rated for the design system pressure.

E. The unit shall be equipped with a heavy gauge welded dust tray.

F. The unit shall be supported from roof structure above as recommended by manufacturers requirements.

G. The collector shall be provided with filters equal to MicroAir Flame Retardant cartridge filters complete with galvanized steel end caps and expanded metal inner and outer liners. Filters shall be replaceable without the use of tools. The filters shall be provided with compressed air pulse cleaning. The filter media shall be designed for pulse cleaning and shall have a minimum of MERV 16 with 0.3 micron, 0.2% - 0.5% moisture absorption, a maximum operating temperature of 180 degrees F., and be flame retardant as specified in TAPPI T461.

A. The clean air plenum shall be lined with minimum 3/4" silencing foam liner

2.3 The air cleaner unit shall have a diffuser inlet plenum. The diffuser plenum provides a means of connecting ductwork to the inlet of the air cleaner. It also serves to diffuse the air evenly across the inlet of the unit to minimize capture efficiency.

A. The plenum shall be constructed of 16 gauge seam welded steel with 1-1/8 inch flanges for connection to unit. The plenum shall have a perforated plate with 50 percent open area (1/2 inch holes on 11/16 inch center) located 18 inch from the inlet of the unit. The collars, to which ductwork is to be attached, should be centered on the face of plenum to aid in air distribution. An access panel should be located between the inlet of the plenum and the diffuser plate for cleaning purposes.

2.4 ROUND SPIRAL DUCTWORK FOR MEDIUM AND HIGH VELOCITY FUME COLLECTION SYSTEMS SHALL BE AS FOLLOWS:

A. Round duct shall be manufactured of galvanized steel by the following methods and gauges listed.

DIAMETER	MINIMUM GAUGE	METHOD OF MANUFACTURE
3 through 14 inches	26 ga.	Spiral Lockseam
15 through 26 inches	24 ga.	Spiral Lockseam
27 through 36 inches	22 ga.	Spiral Lockseam

B. The spiral duct shall have locked seams so made to eliminate any leakage under the pressure for which the system has been designed.

C. Spiral duct shall be provided in 10 foot lengths for accurate fitting.

D. Provide blast gates at each vertical duct drop to fume hood connection. Blast gates shall be easily accessible.

2.5 DUCT FITTINGS FOR ABOVE MENTIONED FUME COLLECTION SYSTEMS SHALL BE AS FOLLOWS:

A. Fittings and couplings shall be made of 20 gauge galvanized steel.

B. Fittings are to have continuous welds along all seams. All divided flow fittings (laterals) are to be manufactured as separate fittings, not as tap collars welded into spiral duct sections. Galvanized areas that have been damaged by welding shall be coated with corrosion resistant aluminum paint.

C. 90 degree tees and 45 degree laterals (wyes) up to and including 12 inch diameter tap size shall have a radiused entrance into the tap, produced by machine or press forming. The entrance shall be free of weld build-up burrs or irregularities.

D. Elbows in diameters 3 inches through 8 inches shall be two section stamped elbows. Other elbows shall be gored construction with seams continuous/welded. Elbows shall be fabricated to a centerline radius of 1.5 times the cross-section diameter. Elbows, not die-stamped, shall be fabricated according to the following schedule:

ELBOW ANGLE	NUMBER OF GORES
Less than 35 degrees	2
36 degrees through 71 degrees	3
Over 71 degrees	5

E. Couplings for round high pressure duct pipe-to-pipe joints in diameters to 60 inches shall be by the use of sleeve couplings, reinforced by rolled beads.

F. Pipe-to-fitting joints in diameters to 60 inches shall be slip-fit of projecting collar of the fitting into the pipe.

G. Insertion length of sleeve coupling and fitting collar shall be 2 inches.

PART 3 EXECUTION

3.1 INSTALLATION

A. Refer to Drawings for general location of the air cleaner equipment. Proper clearances must be maintained for component access, electrical access, bottom working clearance, and air discharge against walls or other obstructions must be considered.

B. Air cleaner units shall be suspended from the structure with threaded rod and spring type vibration isolators. Refer to manufacturer's installation instructions.

END OF SECTION 23 80 61

SECTION 23 82 39 - UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cabinet unit heaters with centrifugal fans and electric-resistance heating coils.
   2. Propeller unit heaters with electric-resistance heating coils.

1.2 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

1.4 INFORMATIONAL/QUALITY ASSURANCE/CONTROL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Suspended ceiling components.
   2. Structural members to which unit heaters will be attached.
   3. Method of attaching hangers to building structure.
   4. Size and location of initial access modules for acoustical tile.
   5. Items penetrating finished ceiling, including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
   6. Perimeter moldings for exposed or partially exposed cabinets.

1.5 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Cabinet Unit Heater Filters: Furnish one spare filter for each unit.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Berko Electric Heating; a division of Marley Engineered Products.
   2. Indeeco.
   3. Markel Products; a division of TPI Corporation.
   4. Marley Electric Heating; a division of Marley Engineered Products.
   5. QMark Electric Heating; a division of Marley Engineered Products.
   6. Raywall

B. Description: A factory-assembled and -tested unit complying with ARI 440.
   1. Electric cabinet unit heaters shall comply with UL 2021.

C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall be aluminum-foil facing or erosion-resistant coating to prevent erosion of glass fibers.
   1. Thickness: 1/2 inch.
   2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
   3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
   4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.

D. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
   1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch thick, galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
   2. Recessing Flanges: Steel, finished to match cabinet.
   3. Control Access Door: Key operated.
   4. Base: Minimum 0.0528-inch thick steel, finished to match cabinet, 4 inches high with leveling bolts.
   5. False Back: Minimum 0.0428-inch thick steel, finished to match cabinet.

E. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Glass Fiber Treated with Adhesive: 80 percent arrestance and MERV 5.

F. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

G. Fan and Motor Board: Removable.
   1. Fan: Forward curved, high static, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.

2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

H. Electrical Connection: Factory wire motors and controls for a single field connection.
1. Disconnect switch.
2. Motor speed controller.

2.2 PROPELLER UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Airtherm; a Mestek Company.
2. Indeeco.
3. Markel Products; a division of TPI Corporation.
4. Marley Electric Heating; a division of Marley Engineered Products.
5. QMark Electri Heating; a division of Marley Engineered Products.
6. Raywall.

B. Description: An assembly including casing, coil, fan, and motor in vertical or horizontal discharge configuration with adjustable discharge louvers.

C. Electric unit heaters shall comply with UL 2021.

D. Cabinet: Removable panels for maintenance access to controls.

E. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

F. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

G. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.
1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

H. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

I. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Motor Type: Permanently lubricated, multispeed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cabinet unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric or spring hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

D. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Comply with safety requirements in UL 1995.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 82 39

DIVISION 26

ELECTRICAL

SECTION 26 00 05 – ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 DEMOLITION SUMMARY

A. This Section Includes Electrical Demolition which includes but is not limited to:
   1. Electrical Service.
   2. Mechanical equipment.
   3. Luminaires.
   4. Electrical panels.
   5. Electrical receptacles.
   6. Fire Alarm System or devices.
   7. Conduit
   8. Underground work
   9. Grounding
   10. Low Voltage cabling/devices – By Owner

B. Refer to drawings for additional requirements

1.2 DEFINITIONS

A. Refer to abbreviations on Symbol Legend drawings

B. Refer to Demolition Coded Notes on drawings

1.3 COORDINATION

A. Contractor shall visit project site before bidding. Verify all conditions, electrical equipment required for demolition and additional demolition that would interfere with new construction.

B. Refer to architectural, mechanical and plumbing demolition drawings for electrical equipment that will be removed or disconnected, and include in bid.

C. Coordinate arrangement, mounting, and support of electrical equipment.

D. Electrical service to the building or any section of this building shall be maintained at all times. If any outage is required, contractor shall obtain written approval from owner or cm at least 48 hours prior to outage.

E. The integrity and functionality of the fire alarm system shall be maintained to provide continuous operation during construction. If an outage is required it must be approved in writing by the authority having jurisdiction.

PART 2 - ELECTRICAL NOTES

2.1 All equipment and conduit shown on the demolition drawings is existing and shall remain in service unless noted otherwise.

2.2 All exposed conduit noted to be removed shall be removed in its entire length, unless noted otherwise.

2.3 All concealed conduit noted to be removed shall be removed for exposed portions and abandoned in concealed location, unless noted otherwise. Remove all conductors and cap remaining conduit at both ends.

2.4 All underground conduit noted to be removed shall be removed for exposed portions and abandoned in underground location, unless noted otherwise. Remove all conductors and cap remaining conduit at both ends.

2.5 All conductors noted to be removed, or in conduit which is noted to be removed, shall be removed in its entirety

2.6 All conductors scheduled to be removed shall be disposed of, unless noted below or otherwise.

2.7 All luminaires scheduled to be removed, shall be carefully removed by contractor and disposed of, unless noted below or otherwise. Remove conduit drop to fixture.

2.8 Panel and equipment designations indicated are existing. Refer to new drawing panel board schedule for any new designations. Provide new nameplate as required.

2.9 Provide blank cover plates where devices are removed and flush box will remain.

2.10 Where walls to remain are damaged by demolition of electrical equipment, patch or repair to match adjacent surfaces and repaint.

2.11 All conduit that is reused shall be re-supported as required per National Electrical Code.

2.12 When existing circuit conductors are required to be reused, verify continuity, intercept in a new or existing junction box or wireway. Extend new conductors as required per National Electrical Code. Do not splice existing conductors in panelboards. Label conductors as each end.

2.13 Wright State University (WSU) will remove any IT equipment and/or cabling throughout construction. The Contractors shall remove all related boxes and conduits made obsolete due to demolition by WSU and coordinate removals to maintain the construction schedule.

PART 3 - EXECUTION

3.1 When existing equipment that is required to be removed shall be removed by Contractor and disposed of offsite unless noted otherwise. Non-Hazardous demolition and construction waste related to the electrical scope of work shall be salvaged, or recycled as much as possible. See specification section 017419- “Construction Waste Management and Disposal” for requirements.

3.2 When existing equipment that is required to be relocated it shall be carefully removed with all components, stored in a dry location, protected, cleaned and re-installed where shown.

3.3 When existing luminaires are required to be relocated, they shall be cleaned and re-lamped with the appropriate lamp.

3.4 Hazardous Demolition Waste. Hazardous demolition and construction waste related to the electrical scope of work shall be disposed of or recycled. See specification section 017419- “Construction Waste Management and Disposal” for requirements. The following materials may be present and if so must be disposed of in compliance with statutory requirements.

A. Polychlorinated Bi-phenol liquids, (PCB’s) such as but not limited to Askarel.

B. Liquid filled transformers with liquids such as but not limited to mineral oil, high molecular weight hydrocarbons (MWHC), Silicone, etc

PCB ballasts or capacitors and asbestos insulation on conductors.

C. Lamps containing mercury, such as but not limited to compact fluorescent (CFL), mercury vapor, etc

D. Fluorescent lamps containing phosphors

E. Lead acid and other rechargeable batteries with heavy metals.

END OF SECTION 26 00 05

SECTION 26 00 50 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Electrical equipment coordination and installation.
2. Substitutions
3. Sleeves for raceways and cables.
4. Sleeve seals.
5. Grout.
6. Common electrical installation requirements.
7. Plywood backing panels.

1.2 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

C. Provide: Furnish and Install

1.3 SUBSTITUTIONS

A. Refer Division 01, Section 012500, Substitution Procedures for contractual requirements

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Submission of the "Substitution Request Form" and complete technical data for evaluation must accompany requests for A/E's approval. All materials for evaluation must be received by the Project Manager and Specification Department at least ten days prior to bid due date. If a manufacturer substitution is approved and allowed, it will be issued by Addendum.

C. It is the Contractors responsibility to prove that the product submitted for substation is equal or exceeds the requirements. The Engineer's decision will be based on samples submitted and technical literature presented. If the information provided is not adequate, then the substation shall be denied.

1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Equipment, furnished by others but installed by Division 26 shall include, but is not limited to: variable frequency controllers, variable speed controllers, motor starters, pump controllers, disconnect switches, flow switches, pressure switches and other control devices. Refer to Mechanical system drawings and specifications, such as Division 23, which shall require equipment to be furnished by them, but installed by others. Division 26 Contractor shall review those documents and make provisions to install that equipment. Refer to specification section 26 29 13 for additional requirements.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

D. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

E. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.
   1. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
      b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   2. Pressure Plates: Carbon steel. Include two for each sealing element.
   3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, not less than 3/4-inch nominal thickness.
   1. Fire-Retardant-Treated Materials: Comply with performance requirements in AWPA C27.
      a. Use Interior Type A, unless otherwise indicated.
      b. Fire retardant treated wood products shall be free of halogens, sulfates, amononium phosphate, and formaldehyde.
   2. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

N. Interior Sleeves for Fiber Optical and Voice and Data Communications Cables: Construct of 2-inch metallic conduit, unless otherwise indicated, with insulated bushings on each end.
   1. Length: 12 inches longer than width of wall.

2. Location: Install 12 inches above finished ceiling.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 PLYWOOD BACKING PANEL INSTALLATION

A. Provide in main cross-connect/equipment rooms, telecommunication rooms, and other locations indicated.

B. Install vertically, 12 inches above finished floor.

C. Paint plywood backing panels with two coats of fire-retardant paint. Do not paint over classification marking of testing and inspecting agency.

3.5 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Firestopping."

END OF SECTION 26 05 00

SECTION 26 05 05 - ELECTRICAL TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for electrical field testing and inspecting of all electrical systems for this project. Each Division 26 Section shall reference components that require testing. The detailed requirements shall be defined in this section, including but not limited to the following:
   1. Qualifications of testing agencies and their personnel.
   2. Suitability of test equipment.
   3. Calibration of test instruments.
   4. Coordination requirements for testing and inspecting.
   5. Reporting requirements for testing and inspecting.

1.2 QUALITY ASSURANCE

A. Testing Agency Qualifications: As specified in each Section containing electrical testing requirements and in subparagraph and associated subparagraph below.
   1. Independent Testing Agencies: Independent of manufacturers, suppliers, and installers of components to be tested or inspected.
      a. Testing Agency's Field Supervisor for Power Component Testing: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Division 16 power component Sections.

B. Test Equipment Suitability: Comply with NETA ATS, Acceptance Testing Specification, Section 5.2.

C. Test Equipment Calibration: Comply with NETA ATS Acceptance Testing Specification, Section 5.3.

PART 2 - PRODUCTS

2.1 COMPONENTS TO BE TESTED

A. Low Voltage Cables, Section 26 05 19
   1. Perform the following field tests and inspections:
      a. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
      b. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Test Reports: Prepare a written report to record the following:
      a. Test procedures used.
      b. Test results that comply with requirements.
      c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
   3. Remove and replace malfunctioning units and retest as specified above.

B. Grounding and Bonding, Section 26 05 26
   1. Perform the following tests and inspections:
      a. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
      b. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
         1) Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than

natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

2) Perform tests by fall-of-potential method according to IEEE 81.

c. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

2. Test Reports: Prepare a written report to record the following:
   a. Test procedures used.
   b. Test results that comply with requirements.
   c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements
3. Report measured ground resistances that exceed the following values:
   a. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
   b. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
   c. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   d. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
   e. Substations and Pad-Mounted Equipment: 5 ohms.
   f. Manhole Grounds: 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values above, notify Architect/Engineer promptly. Provide additional grounds rods connected to the building ground ring or offer recommendations to reduce ground resistance.

C. Low-Voltage Transformers, Section 26 22 00
1. Perform the following field tests and inspection:
   a. After installing transformers but before primary is energized, verify that grounding system at substation is tested at specified value or less.
   b. After installing transformers and after electrical circuitry has been energized, test for compliance with requirements.
   c. Perform visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   d. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Test Reports: Prepare written reports to record the following:
   a. Test procedures used.
   b. Test results that comply with requirements.
   c. Test results that do not comply with requirements and corrective actions taken to achieve compliance with requirements.
3. Remove and replace units that do not pass tests or inspections and retest as specified above.
4. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

D. Wiring Devices, Section 26 27 26
1. Perform tests and inspections and prepare test reports.
   a. Test Instruments: Use instruments that comply with UL 1436.
   b. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
2. Tests for Convenience Receptacles:
   a. Line Voltage: Acceptable range is 105 to 132 V
   b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
   c. Ground Impedance: Values of up to 2 ohms are acceptable.
   d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

e. Using the test plug, verify that the device and its outlet box are securely mounted.
f. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above:

E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of the following equipment. Remove front and rear panels so joints and connections are accessible to portable scanner.
1. Each section of [Medium voltage switchgear, Medium voltage transformers, Medium voltage pad mounted switches and secondary unit substations].
2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each piece of equipment tested, 11 months after date of Substantial Completion.
3. Instrument: Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes infrared-scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
5. Provide an electronic copy of results on a DVD or flash drive

PART 3 - EXECUTION

3.1 GENERAL TESTS AND INSPECTIONS

A. If a group of tests are specified to be performed by an independent testing agency, prepare systems, equipment, and components for tests and inspections, and perform preliminary tests to ensure that systems, equipment, and components are ready for independent agency testing. Include the following minimum preparations as appropriate:
1. Perform insulation-resistance tests.
2. Perform continuity tests.
3. Perform rotation test (for motors to be tested).
4. Provide a stable source of single-phase, 208/120-V electrical power for test instrumentation at each test location.

B. Test and Inspection Reports: In addition to requirements specified elsewhere, report the following:
1. Manufacturer's written testing and inspecting instructions.
2. Calibration and adjustment settings of adjustable and interchangeable devices involved in tests.
3. Tabulation of expected measurement results made before measurements.
4. Tabulation of "as-found" and "as-left" measurement and observation results.

END OF SECTION 26 05 05

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:
   1. Division 26 Section "Common Work Results for Electrical" for sleeves and sleeve seals for cables.
   2. Division 27 Section "Communications Copper Horizontal Cabling" for cabling used for voice and data circuits.

1.2 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70.

B. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN, XHHW, and SO
   1. Provide No. 6 AWG and smaller conductors with color-coded insulation.

C. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC, and Type SO with ground wire.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper, No. 10 AWG, minimum.
   1. Feeder Conductor sizes indicated on drawings are for copper conductors, unless indicated otherwise.
   2. Branch Circuits: Copper. No. 12 AWG, minimum.

B. Class 1 Control Circuits: Copper. No. 14 AWG, minimum.

C. Class 2 Control Circuits: Copper. No. 16 AWG, minimum.

D. Voltage drop shall not exceed 3 percent from panelboard to farthest outlet.
   1. Maximum permitted length of 20 amp, 120, 208, and 240 volt circuits using No. 12 AWG copper wire is 100 feet.

2. Maximum permitted length of 20 amp, 120, 208, and 240 volt circuits using No. 10 AWG copper wire is 140 feet.
3. Maximum permitted length of 20 amp, 277 and 480 volt circuits using No. 12 AWG copper wire is 170 feet.
4. Maximum permitted length of 20 amp, 277 and 480 volt circuits using No. 10 AWG copper wire is 250 feet.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway; or Type XHHW, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway; or Type XHHW, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway; or Type XHHW, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Installed in Accessible Ceiling Spaces and Gypsum-Board Partitions: Type THHN-THWN, single conductors in raceway; or metal-clad cable, Type MC; or manufactured wiring system.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. Class 1 Control Circuits: Type THHN-THWN, in raceway.

J. Class 2 Control Circuits: Type THHN-THWN, in raceway; power-limited cable, concealed in building finishes; or power-limited tray cable, in cable tray.
1. Exposed-Structure Type Ceiling Spaces: Install Class 2 control circuits in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

E. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

G. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
   2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.2 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. EF: Entrance Facility for voice and data communications.

C. ER: Equipment Room for voice and data communications.

D. MC: Main Cross-Connect for voice and data communications.

E. TBB: Telecommunications Bonding Backbone conductor.

F. TDMM: Telecommunications Distribution Methods Manual, published by BICSI.

G. TGB: Telecommunications Grounding Busbar.

H. TMBC: Telecommunications Main Bonding Conductor (same as ANSI-J-STD-607-A Bonding Conductor for Telecommunications.)

I. TMGB: Telecommunications Main Grounding Busbar.

J. TR: Telecommunications Room for voice and data communications.

1.3 SUBMITTALS

A. Quality Assurance/Control Submittals:
   1. Field quality-control test reports.

B. Closeout Documents:
   1. Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
      a. Test wells.
      b. Building Ground rods.
      c. Ground rods at light poles
      d. Ground rings.
      e. Connections to building steel
      f. Connections to roof steel
   2. Photographs- Take a minimum of 15 digital photo graphs with visible dates, documenting the concealed or buried grounding components noted in the previous paragraph.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Voice and Data Communications Equipment Grounding: Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter, and comply with ANSI-J-STD-607-A.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 4 inches in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.

C. All cable to cable, cable to rod, cable to steel connection shall be welded connectors: Use exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions. Exothermic welds shall use powdered copper oxide and aluminum to form a molded homogeneous copper joint connection between the copper conductor and the material being bonded to.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 5/8-inch-diameter by 8 feet in length as shown on drawings. If no drawing details are included, then provide 3/4-inch-diameter by 10 feet in length.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Comply with IEEE C2 grounding requirements.

B. Refer to grounding details on drawings which take precedence. If no drawing details are included, then provide the following.

C. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
1. Bury at least 24 inches below grade.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus on insulated spacers 1 inch, minimum, from wall 24 inches above finished floor, unless otherwise indicated.
   2. Dimensions: 1/4-by-4-by-12-inches.

E. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Exothermic-welded connectors, except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Exothermic-welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors. Provide a Copper-clad steel ground rod; 5/8-inch-diameter by 8 feet in length at each light pole in excess of 12 feet tall. Bond ground rod to a ground lug in the lighting pole with a minimum #6 bare solid conductor routed up through a ½ " PVC conduit.

3.3 TECHNOLOGY SYSTEM GROUNDING

A. Voice and Data Communication Equipment: For telephone, video, voice and data, and other communication equipment.
   1. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
   2. Comply with ANSI-J-STD-607-A.
   3. Refer to grounding details on drawings which take precedence. If no drawing details are included, then provide the following:
      a. MC/ER: Install 1/4-by-4-by-20-inch copper TMGB. Bond TMGB to the following:
         1) Electrical service entrance grounding bus with No. 3/0 AWG TMBC.
         2) Structural steel with No. 2 AWG insulated grounding conductor.
         3) Cable trays and metallic pathways.
   4. Refer to grounding details on drawings which take precedence. If no drawing details are included, then provide the following:
      a. TR: Install 1/4-by-2-by-12-inch copper TGB. Bond TGB to the following:
         1) TMGB with No. 3/0 AWG TBB.
         2) Structural steel with No. 2 AWG insulated grounding conductor.
         3) Cable trays and metallic pathways.

B. Refer to grounding details on drawings which take precedence. If no drawing details are included, then provide the following. Signal and Communication Equipment: For sound, alarm, security, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.

3.4 INSTALLATION

A. Comply with NECA 331.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or 12 inches below final grade, unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
   2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
   3. When ground rod cannot be driven vertically due to shallow bedrock, drive at 45 degree angle so that the top if 12 inches below grade.
   4. When D2 and D3 cannot be installed, bury ground rods as deep as possible but 30 inches minimum to top.
   5. When D2, D3, and D4 cannot be installed, use electrolytic ground rod shall be 2 inch diameter, hollow Type K copper tube, drilled 12 feet deep into rock, straight shaft with No. 4/0 copper conductor exothermically welded to tube, 12 inches from top end. Conductor length shall be as required to run to main grounding bus bar in buildings. Tube shall have weep holes drilled in sides near ends and shall be prefilled with metallic salts. Provide protective access box shall be 10 inches diameter, 12 inches deep, hollow precast concrete with cast iron cover. Provide backfill material shall be as recommended by manufacturer.

D. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install with removable cover at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Handholes and Manholes: Provide a ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.

F. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts. Install at expansion joints.
   2. Catwalks: Bond straps directly to catwalks and basic structure, taking care not to penetrate any adjacent parts.
   3. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
   4. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

G. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

3.5 VARIABLE FREQUENCY MOTOR CONTROLLERS

A . Ensure that VFC and motor frame are properly bonded to the grounding conductor and that equipment grounding conductor is provided in the feeder conduit to the VFC and motor.

3.6 IDENTIFICATION

A. Identify voice and data communications equipment grounding components, complying with TIA/EIA-606-A.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.
   3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
   5. Substations and Pad-Mounted Equipment: 5 ohms.
   6. Manhole Grounds: 10 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values above, notify Architect/Engineer promptly. Provide additional grounds rods connected to the building ground ring or offer recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

B. Related Sections include the following:
   1. Division 26 Section “Identification for Electrical Systems” for cable ties.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   2. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   3. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
   1. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
   2. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
   3. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Not permitted.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
   6. Toggle Bolts: All-steel springhead type.
   7. Hanger Rods: Threaded steel.
   8. Wire Rope Systems: Galvanized steel wire rope with spring-loaded, key-releasable locking device with the following rated strength:
      a. 0.059-inch (1.5-mm): 44 pounds.
      b. 5/64-inch (2-mm): 100 pounds.
      c. 1/8-inch (3-mm): 200 pounds.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SLOTTED SUPPORT SYSTEMS APPLICATIONS

A. Heated Interior Spaces: Painted steel.

B. Non-Heated Interior Spaces and Outdoors: Hot-dipped galvanized steel.

3.3 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
   6. To Light Steel: Sheet metal screws.
   7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

F. Exposed Conduits: Use one-hole or two-hole straps 8 feet or less AFF. Conduit clamps and hangers that project past the conduit wall are limited to above 8 feet AFF.

G. Do not use wood plugs, perforated metal bands, chain, or wire to support electrical equipment, unless otherwise indicated.

H. Open-Web Joists: Install supports only at panel points. Fasten supports to top of bottom chord of joist. Do not exceed 100 pounds working load per panel point.

I. Roof and Elevated Floor Decks: Do not fasten supports to roof decks or elevated floor decks.

3.4 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.5 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base. Chamfer edges 1 inch.
   1. Base Height: 3.5 inches, unless indicated otherwise.

B. Use 4500-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.6 CONCRETE CURBS

A. Construct concrete curbs of dimensions indicated but not less than 4 inches larger in both directions than outline of electrical enclosures above, so conduits will be a minimum of 2 inches from edge of the base. Chamfer edges 1 inch.
   1. Base Height: Match finish wall base material, but not less than 3.5 inches.

B. Use 4500-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

3.7 PAINTING

A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - CONDUIT AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes conduits, fittings, boxes, outlet boxes, floor boxes, high capacity floor boxes enclosures, and cabinets for electrical wiring. The term raceway shall also apply to conduit and boxes.

B. Related Sections include the following:
1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Division 26 Section "Wiring Devices" for mounting heights of devices.
3. Division 26 Section "Surface Raceways for Electrical Systems" for multioutlet assemblies wireways and surface raceways.

1.2 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. EMT: Electrical metallic tubing.

C. ER: Equipment room (Telecommunications.)

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. MC: Main cross-connect (Telecommunications.)

H. RMC: Rigid metal conduit.

I. RNC: Rigid nonmetallic conduit.

J. TDMM: Telecommunications Distribution Methods Manual, published by BICSI.

K. TR: Telecommunications room.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Voice and Data Communications Pathways: Install conduit, raceways, and boxes according to BICSI TDMM, "Horizontal Distribution Systems" Chapter, and comply with NECA 568.

D. Review WSU Standards of Design packet along with WSU Infrastructure and Design Standards.

1.4 COORDINATION

A. HVAC Control and Monitoring: Verify locations of temperature control panels with Building Management System installer.

B. Telephone and Cable Television: Verify location of entrance facilities and exterior underground pathways with Telephone and Cable Television Utility Companies.

C. MC/ER and TR: Verify locations of backboards, cable trays, equipment cabinets and racks, and conduit stub-outs.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. RMC: ANSI C80.1.

B. IMC: ANSI C80.6.

C. EMT: ANSI C80.3.

D. FMC: Zinc-coated steel or aluminum.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Die-cast type, pot-metal type, and indenter type fittings are not permitted.
2. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
3. Fittings for EMT: Steel, compression type.

G. Joint Compound for RMC or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT

A. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

B. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
1. Gangable boxes are not permitted.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

D. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.

F. Cabinets:
1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

2.4 TELCOMMUNICATIONS CONDUIT BODIES

A. General Description: Conduit bodies specifically designed to maintain the required bend radius for data and communications cabling, complying with BISCI TDMM “Horizontal Distribution Systems” Chapter.
   1. Material: Die-cast aluminum.
   2. Conduits run to the cable tray should end approximately 4"- 6" inches away from the top or bottom edge of the cable tray to maintain a proper bend radius.
   3. Refer to ET drawings General Notes column and ET51 for further details.
   4. REFER TO PAGE 3 I Part FOUR 26 OF THE WRIGHT STATE UNIVERSITY CONSTRUCTION ELECTRICAL SPECIFICATIONS FOR COLOR IDENTIFICATION OF ALL CONDUITS. Voice/Data/Video/Security conduit is Blue (12809)
   5. REFER TO PAGE 1 I Part FOUR 28 OF THE WRIGHT STATE UNIVERSITY CONSTRUCTION ELECTRICAL SPECIFICATIONS FOR SECURITY DOOR AND CAMERA ROUGH-INS.

PART 3 - EXECUTION

3.1 CONDUIT APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
   1. Exposed Conduit: RMC or IMC.
   2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed and Subject to Physical Damage: RMC. Includes raceways in the following locations:
      a. Loading dock.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Kitchens.
   3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   4. Concealed in Exterior Walls: RNC, Type EPC-40-PVC
   5. Concealed Under Slabs-on-Grade: RNC, Type EPC-40-PVC.
   6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   7. Damp or Wet Locations: RMC or IMC.
   8. Conduits for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
   9. Conduits for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
   10. Conduits s for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
   11. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum RMC, IMC, EMT, or RNC, Type EPC-40-PVC Size: 1/2-inch trade size, unless indicated otherwise.

D. Minimum FMC or LFMC Size: 1/2-inch trade size, unless indicated otherwise.

E. Conduit Fittings: Compatible with raceways and suitable for use and location.
   1. RMC or IMC: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 OUTLET AND DEVICE BOX APPLICATION

A. Flush Boxes in Masonry Walls and Partitions: Use masonry boxes at least 3.5 inches deep.

B. Flush Boxes in Gypsum-Board Partitions: Use square boxes at least 2.125 inches deep with raised box covers.

C. Flush Device Boxes in Ceilings: Use square boxes at least 2.125 inches deep with raised box covers.

D. Flush Outlet Boxes in Ceilings: Use 4-inch round or octagonal boxes at least 2.125 inches deep.

E. Surface Boxes: Use cast-metal type with matching cover. Provide knock-out plugs in unused openings.

3.3 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support conduits as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Conceal conduit and EMT within finished walls, ceilings, and below floors, unless otherwise indicated.

G. Conduits Beneath Concrete Slabs:
   1. Install conduit parallel or at right angles building lines, at least 1 inch below top of drainage fill.
   2. Arrange conduits to cross building expansion joints at right angles with expansion fittings.
   3. Do not embed conduits in concrete slabs.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Conduit Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

K. Install conduit sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed conduits, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install conduit sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

L. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
   1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
   3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

M. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in damp or wet locations.

N. Recessed Boxes in Masonry Walls: Coordinate work with masonry contractor. Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Box shall be vertically plumb and flush with plane of wall, or slightly recessed. All boxes installed improperly will be replaced at Contractors expense. Provide oversized plate for all boxes that have exposed joints.

O. Recessed Boxes in Gypsum-Board Partitions: Coordinate work with drywall contractor. Box shall be vertically plumb and flush with plane of wall, or slightly recessed. All boxes installed improperly will be replaced at Contractors expense. Provide oversized plate for all boxes that have exposed joints.

P. The floor box shall be FSR FL-640P-8”, Contractor should confirm divider & conduit layout into floor box with electrical details prior to installation.

Q. Conduits less than 3-inch trade size may be field bent, unless indicated otherwise. Use factory 45 and 90 degree, and special radius elbows for conduits 3-inch and larger.

R. Conduits for Feeders: Electrically continuous, terminated with grounding and insulating bushings.

S. Conduits for Branch Circuits: Electrically continuous.

T. Finished Spaces: Provide escutcheons where conduits penetrate surfaces of finished spaces. Match finish of adjacent surfaces.

U. Conduits for Optical Fiber and Voice and Data Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
   1. 1-1/2-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
   2. 2-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
   3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
   4. Elbows: Use factory elbows. Field bent elbows are not permitted for optical fiber and communications cables.
      a. Radii of Elbows for Conduits 1-1/2-inches and Larger: At least 10 times inside diameter of conduit.
   5. Conduit Bodies: Use telecommunications conduit bodies.

3.4 NON-METALLIC CONDUIT

A. Provide a continuous equipment ground conductor in all conduits with branch circuits or feeders.

B. Do not use steel, metallic conduit for any bare grounding conductors.

3.5 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 37 - WIRE MESH TYPE CABLE TRAYS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes rigid steel wire mesh cable trays and accessories.

1.2 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Cable tray shall be stored in a well-ventilated, dry location. Unpack and dry wet materials before storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cablofil; a Division of ICM Group.
   2. Chalfant Manufacturing Company.
   3. Cooper B-Line, Inc.
   4. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
   5. GS Metals Corp.; FLEXTRAY products.
   6. MONO-SYSTEMS, Inc.
   7. Niedax-Kleinhuis USA, Inc.
   8. PW Industries.
   9. The Wiremold Co.

B. Products of other manufacturers will be considered for acceptance only when allowed in Section 260050, General Electrical Requirements.

2.2 MATERIALS AND FINISHES

A. Cable Trays, Fittings, and Accessories: Continuous rigid 4-inch by 2-inch steel wire mesh, complying with ASTM A510 and NEMA VE 1, listed and labeled as an equipment grounding conductor.
   1. Electrogalvanized after fabrication, complying with ASTM B 633 SC1/SC2; with hardware galvanized according to ASTM B 633 or AISI Type 304 stainless steel.

B. Sizes and Configurations: Refer to Part 3 Article "Cable Tray Schedule" for specific requirements for types, materials, sizes, and configurations.

2.3 CABLE TRAY ACCESSORIES

A. Fittings: Field fabricated tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

B. Remove burrs and sharp edges from cable trays.

C. Fasten cable tray supports to building structure.
1. Design each fastener and support to carry load indicated.
2. Place supports so that spans do not exceed a maximum distance of 10 feet.
3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
4. Support bus assembly to prevent twisting from eccentric loading.
5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
6. Locate and install supports according to NEMA VE 2.

D. Make changes in direction and elevation using standard fittings.

E. Make cable tray connections using standard fittings.

F. Seal penetrations through fire and smoke barriers with re-enterable fire-rated pathways according to Division 07 Section "Firestopping." Provide quantity to match cross sectional area of cable tray:

G. Workspace: Install cable trays with enough space to permit access for installing cables. . The cable tray system shall have 1'-0" clearance measured from the top most surface of the tray. Access from the sides shall be 6" to 1'. Access to the cable tray from below shall be unobstructed its entire length. There shall be no other equipment, lights, conduits, fixtures etc. attached to, mounted on, running through or on the cable trays except those needed to support the tray systems. Cable tray may not be run through walls.

3.2 CABLE INSTALLATION

A. Install cables only when cable tray installation has been completed and inspected.

B. On vertical runs, fasten cables to tray every 18 inches. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

C. In existing construction, the owner shall remove inactive or dead cables from cable tray.

3.3 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions and Division 26 Section "Grounding and Bonding for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
   1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
   2. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
   3. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
   4. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
   5. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
   6. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

B. Report results in writing.

3.5 PROTECTION

A. Protect installed cable trays.
   1. Install temporary protection for cables in open existing trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

3.6 CABLE TRAY SCHEDULE

A. Provide run designation Type-A, unless otherwise indicated.

B. Run Designation Type-A:
   1. Type: Wire mesh, trapeze type hanger.
   2. Width: 12 inches.
   3. NEMA VE 1 Loading Depth: 4 inches.
   4. NEMA VE 1 Span Load: L/200.

C. Run Designation Type-B:
   1. Type: Wire mesh, trapeze type hanger.
   2. Width: 18 inches.
   3. Minimum Fitting Radius: 12 inches.
   4. NEMA VE 1 Loading Depth: 4 inches.
   5. NEMA VE 1 Span Load: L/200.

END OF SECTION 26 05 37

SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
   2. Handholes and boxes.

1.2 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.3 SUBMITTALS

A. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Reinforcement details.
   3. Frame and cover design and manhole frame support rings.
   4. Ladder details.
   5. Grounding details.
   6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
   7. Joint details.

B. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Cover design.
   3. Grounding details.
   4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

C. Quality Assurance/Control Submittals:
   1. Product Data: For the following:
      a. Duct-bank materials, including separators and miscellaneous components.
      b. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
      c. Accessories for manholes, handholes, and boxes.
      d. Warning tape.
   2. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.
   3. Source quality-control test reports.
   4. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect/Engineer.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Galvanized.Steel Conduit: Comply with ANSI C80.1. Use RGS when noted in this specification or where required on drawings.

B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

B. Duct Accessories:
   1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
   2. Warning Tape: Underground-line warning tape specified in Division 260553 Section "Identification for Electrical Systems."

2.3 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.
   1. Color:
      a. Paved and Off-Road Locations: Gray.
      b. Grass and Turf Locations: Green.
   2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
   3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
   4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   5. Cover Legend: Molded lettering. Selected to suit system.

a. Legend: "ELECTRIC" for duct systems with power wires and cables for systems operating at 600 V and less.
b. Legend: "COMMUNICATIONS" for communications, data, and telephone duct systems.

6. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600 V and Less: RNC**,** NEMA Type EB-20-PVC, in concrete-encased duct bank, unless otherwise indicated. A feeder is defined as any circuit shown on the one line diagram or any circuit with an overcurrent device in excess of 150 amperes. Underground feeders below concrete slab on grade shall be excluded from the requirement of concrete encasement.

B. Underground Ducts for any electrical feeder or branch that is part of the Emergency System or Optional Standby System or Legally Required Standby System: RNC**,** NEMA Type EB-20-PVC, in concrete-encased duct bank, unless otherwise indicated.

C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, installed in direct-buried duct bank, unless otherwise indicated.

E. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

F. Install underground ducts for telephone, communications, or data utility service cables at least 24 inches from underground ducts for electrical feeders or branch circuits.

G. Underground Ducts Crossing Paved Paths, Walkways, Driveways, and Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.

2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Use one of the following:
   a. Precast concrete. AASHTO HB 17, H-20 structural load rating.
   b. Polymer concrete, SCTE 77, Tier 15 structural load rating.
   c. Fiberglass enclosures with polymer concrete frame and cover, SCTE 77, Tier 15 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Use one of the following:
   a. Precast concrete. AASHTO HB 17, H-10 structural load rating.
   b. Polymer concrete units, SCTE 77, Tier 8 structural load rating.
   c. Heavy-duty fiberglass units with polymer concrete frame and cover, SCTE 77, Tier 8 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin or high-density plastic, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
5. Minimum Dimensions for Telephone, Communications, and Data Wiring Handholes: 30 by 42 by 36-inches deep.
6. Units in Artificial Turf and Synthetic Track Material: Sports Field Pockets.

B. Manholes: Precast or cast-in-place concrete.
1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

3.4 DUCT INSTALLATION

A. Comply with NECA 605.

B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.

D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

E. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
2. Grout end bells into structure walls from both sides to provide watertight entrances.

F. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."

G. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

H. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.

I. Concrete-Encased Ducts: Support ducts on duct separators.
   1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
   2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
      a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
      b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
   3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
   4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
   5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
   6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
   7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
   8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
      a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
      b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
         1) Where steel conduit stub-ups are prohibited by the electrical utility company, use manufactured duct elbows for stub-ups. Extend concrete encasement throughout the length of the elbow
   9. Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at approximately 8 inches below finished grade. As a minimum, bury warning tape approximately 12 inches above concrete envelope. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall. Space additional tapes 12 inches apart, horizontally.

J. Direct-Buried Duct Banks:
   1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches in nominal diameter.
4. Install backfill as specified in Division 31 Section "Earth Moving."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
        1) Where steel conduit stub-ups are prohibited by the electrical utility company, use manufactured duct elbows for stub-ups. Extend concrete encasement throughout the length of the elbow
11. Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at approximately 8 inches below finished grade. As a minimum, bury warning tape approximately 12 inches above ducts. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall. Space additional tapes 12 inches apart, horizontally.

3.5 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line, 42 inches below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
   1. Concrete: 4500 psi , 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
   2. Dimensions: 10 inches wide by 12 inches deep.

3.6 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
   2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.8 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Identification for raceway, more than 600 V.
   2. Identification for conductors and control cable.
   3. Underground-line warning tape.
   4. Warning labels and signs.
   5. Instruction signs.
   6. Equipment identification labels.
   7. Factory nameplates
   8. Miscellaneous identification products.

1.2 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.3 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:
   1. Power Circuits: Black letters on an orange field.
   2. Legend: Indicate system or service and voltage, if applicable.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
   1. Not less than 6 inches wide by 4 mils thick.
   2. Compounded for permanent direct-burial service.
   3. Embedded continuous metallic strip or core.
   4. Printed legend shall indicate type of underground line by name. Use yellow “ELECTRIC” for general use. Use red “HIGH VOLTAGE” for cables in excess of 600 volts. Use “LOW VOLTAGE” for communication, alarm systems telecom cables etc. Use orange “FIBER OPTIC” for fiber optic cables.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

C. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches .

D. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
   1. Engraved legend with black letters on white face.
   2. Punched or drilled for mechanical fasteners.
   3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 IDENTIFICATION LABELS

A. All labels required below in Part 3.0 shall meet the following requirements.
      a. Indoor Equipment: Engraved, laminated acrylic, melamine label or metal. Mounted with corrosion-resistant screws or permanent adhesive.
      b. Outdoor Equipment: Engraved, laminated acrylic, melamine label or metal. Mounted with corrosion-resistant screws.
      c. Nameplates shall have a black or dark-gray background with white engraved letters and numbers
      d. Nameplates for emergency systems or power transfer equipment shall have a red background with white engraved letters and numbers.
      e. Minimum letter height shall be 3/8 inch.
      f. Do not use Kroy labels, paper labels

g. Do not use double stick tape to attach laminated labels.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, fluoropolymer cable ties suitable for ducts or plenums; and other spaces used for environmental air.
   1. Flammability Rating: UL94V-0.
   2. Minimum Width: 3/16 inch .
   3. Tensile Strength: 50 lb, minimum.
   4. Temperature Range: Minus 40 to plus 185 deg F.
   5. Color: Maroon.

B. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Raceways and Duct Banks More Than 600 V Concealed within Buildings: 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:
   1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
   2. Wall surfaces directly external to raceways concealed within wall.
   3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches high, with snap-around labels. Repeat legend at 10-foot maximum intervals.

C. Accessible Raceways and Cables of Fire Alarm Systems: Identify junction boxes by painting boxes and covers red.

D. Power-Circuit Conductor Identification: For primary and secondary conductors No. 4 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

E. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number.

F. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source and circuit number.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install as required in Div 26 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel or metal-backed, butyrate warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.
   2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

J. Instruction Signs:
   1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
   2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

K. Factory installed nameplates. All equipment shall have a factory installed nameplates. Do not install nameplates inside of the equipment. Nameplate shall be metal. Provide the following information on the exterior of panel or inside the door.
   1. UL listing.
   2. Name of manufacturer
   3. Ampere and voltage rating and phasing
   4. Short circuit rating

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with drawings, wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
         1) For single-gang motor starting switches use 3/8-inch high letters on 3/4-inch high by 2.25-inch wide label.
         2) For two-gang motor starting switches, use 3/8-inch high letters on 3/4-inch high by 4 inch wide label.
      b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
      c. (For example) PANEL 1AL1, 1AL2.
   2. Equipment to Be Labeled:
      a. Panelboards, electrical cabinets, and enclosures.
      b. Access doors and panels for concealed electrical items.
      c. Electrical switchgear and switchboards.
      d. Transformers.
      e. Electrical substations.
      f. Emergency system boxes and enclosures.
      g. Motor-control centers.
      h. Disconnect switches.
      i. Enclosed circuit breakers.
      j. Motor starters.

k. Push-button stations.
l. Power transfer equipment.(Identify “Emergency” and “Optional Standby”)
m. Contactors.
n. Remote-controlled switches, dimmer modules, and control devices.
o. Battery inverter units.
p. Battery racks.
q. Power-generating units.
r. Uninterruptible power supply equipment.

M. Electrical Energy Source Identification Labels: On each unit of equipment, install unique label to identify the energy source that is consistent with drawings, wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
a. Indoor Equipment: Unless otherwise indicated, provide a single line of text with 3/8-inch- high letters on 3/4-inch- high label; where 2 lines of text are required, use labels 1.5 inches high.
b. (For example) FED FROM MAIN SWITCHBOARD MSBL.
2. Equipment to Be Labeled:
a. Panelboards, electrical cabinets, and enclosures.
b. Electrical switchgear and switchboards.
c. Transformers.
d. Electrical substations.
e. Emergency system boxes and enclosures.
f. Motor-control centers.
g. Disconnect switches.
h. Enclosed circuit breakers.
i. Motor starters.
j. Power transfer equipment.
k. Contactors.
l. Battery inverter units.
m. Battery racks.
n. Voice and data cable terminal equipment.
o. Master clock and program equipment.
p. Intercommunication equipment.
q. Audio components, racks, and controls.
r. Fire-alarm control panel and annunciators.
s. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
t. Monitoring and control equipment.
u. Uninterruptible power supply equipment.
v. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
w. Junction boxes and pull boxes with covers larger than 5-by-5-inches.
3. For wiring devices: On inside (back) of cover plate, write the panel name for energy source and circuit number with permanent, indelible ink.
4. For small Pull Boxes, and small Junction Boxes (less than 5-by-5-inches): On front of cover plate, write the panel name for energy source and circuit number with permanent, indelible ink.

N. Nominal System Voltage Identification Labels: On each unit of equipment, install unique nominal system voltage and color-coding label that is consistent with drawings, wiring diagrams, schedules, and Operation and Maintenance Manual.
1. Labeling Instructions:
a. Indoor Equipment: Unless otherwise indicated, provide a single line of text with 3/8-inch- high letters on 3/4-inch- high label; where 2 lines of text are required, use labels 1.5 inches high.
b. (For example) 208/120 V, 3 PH-4W

2. Equipment to Be Labeled:
    a. Panelboards.
    b. Electrical switchgear and switchboards.
    c. Motor-control centers.
    d. Safety switches used for service entrance disconnecting means or in mechanical rooms.
    e. Power transfer equipment
    f. Generators

O. Combined equipment labels. When required above a single nameplate can be created for all required information. The equipment identification label MUST appear on the first line and shall be notably larger font than the rest of the information, and all information shall appear on a separate line. (For example)

PANEL 1AL1
208/120 V, 3 PH-4W
FED FROM MAIN SWITCHBOARD MSBL

P. Main Service Entrance Panels or Switchboards AIC Label: Provide an engraved nameplate adjacent to the manufacturers nameplate that dispalys the AIC withstand, with the following data.
1. Maximum available calculated 3 phase fault current. (or single phase when applicable)
2. Current date.

Q. Panelboard Circuit Directories: Provide type-written or laser printed circuit directory on heavy card stock. Arrange in two columns with odd numbered circuits on left and even numbered circuits on right. Include panelboard identification at the top and installation date. Indicate spare circuit breakers: “SPARE”. Install in metal frame with clear plastic cover over directory. Handwritten directories are not acceptable. Indicating the load description for all circuit numbers installed.

R. Feeder and Branch Circuit Load Identification Labels: On each overcurrent protective device, install unique load designation label that is consistent with drawings, wiring diagrams, schedules, and Operation and Maintenance Manual.
1. Labeling Instructions:
    a. Panelboard Circuit Directories: Provide type-written or laser printed circuit directory on heavy card stock. Arrange in two columns with odd numbered circuits on left and even numbered circuits on right. Include panelboard identification at the top and installation date. Indicate spare circuit breakers: “SPARE”. Install in metal frame with clear plastic cover over directory. Handwritten directories are not acceptable. Indicating the load description for all circuit numbers installed.
    b. Lighting and Appliance Branch-Circuit Panelboards: Use room names and numbers furnished by Owner for the actual room numbers. **Do not** use room names and numbers indicated on Contract Drawings. Load description shall identify each circuit number with its clear, evident, and specific purpose. Load description shall include sufficient detail to allow each circuit to be distinguished from all others.
2. Distribution Panels and Switchboards: Provide a load identification nameplate adjacent to each overcurrent protective device. Unless otherwise indicated, provide a single line of text with 3/8-inch high letters on 3/4-inch high label; where 2 lines of text are required, use labels 1.5 inches high.
    a. Label shall identify each circuit number with its clear, evident, and specific purpose. Load description shall include sufficient detail to allow each circuit to be distinguished from all others. **Do not** use paper labels. Use room names and numbers furnished by Owner for the actual room numbers. **Do not** use room names and numbers indicated on Contract Drawings.

S. GFI receptacles: Provide a self adhesive, factory furnished label on receptacles cover plate, “Protected from ground fault device” (or words to that effect). Apply for all standard receptacles that are fed from a ground fault circuit interrupting breaker or fed downstream from a ground fault circuit interrupting receptacle (as a thru feed device).

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Attach signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

E. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
   1. Color shall be factory applied or, for sizes larger than No. 6 AWG if authorities having jurisdiction permit, field applied.
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Neutral: White.
      e. Ground: Green.
   3. Colors for 480/277-V Circuits:
      a. Phase A: Brown.
      b. Phase B: Orange.
      c. Phase C: Yellow.
      d. Neutral: Gray.
      e. Ground: Green.
   4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

F. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

END OF SECTION 26 05 53

SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes specific requirements that apply to implementation of commissioning of electrical systems, assemblies, or components.

B. Related Sections:
   1. Division 01 Section "General Commissioning Requirements" for responsibilities of Contractor, Owner, and Commissioning Authority.

1.2 DEFINITIONS

A. Commissioning. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. This is achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance and the warranty period with actual verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.
   1. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
      a. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
      b. Verify and document proper performance of equipment and systems.
      c. Verify that operation and maintenance documentation left on site is complete.
      d. Verify that the Owner's operating personnel are adequately trained.
   2. The commissioning process does not take away from or reduce the responsibility of the installing contractors to provide a finished and fully functioning product.
   3. Refer to Division 01 Section "General Commissioning Requirements" for complete commissioning plan and specifications.

1.3 SYSTEMS TO BE COMMISSIONED

A. Contractor shall perform commissioning requirements specified in Section 010800 and other sections referenced in Section 010800.

B. The following systems will be commissioned in this project.
   1. Lighting Control Systems
   2. Electrical distribution systems
      a. Power and lighting panelboards
   3. Grounding systems
   4. Thermal Imaging of all power and lighting panels to be included in the electrical scope of work.

C. Perform the following infrared scan tests and inspections and prepare reports:
   1. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
   2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
   3. Instruments and Equipment:
      a. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

1.4 TEST EQUIPMENT

A. Standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the electrical contractor shall ultimately be responsible for standard testing equipment for the electrical system, except for equipment specific to and used by Commissioning Authority in their commissioning responsibilities.

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone datalogging equipment that may be used by the Commissioning Authority.

C. Datalogging equipment and software required to test equipment will be provided by the Commissioning Authority, but shall not become the property of the Owner.

D. Testing equipment shall be of sufficient quality and accuracy to test and measure system performance with the tolerances specified in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 26 08 00

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following lighting control devices:
   1. Time switches.
   2. Outdoor and indoor photoelectric switches.
   3. Indoor occupancy sensors.
   4. Outdoor motion sensors.
   5. Lighting contactors.
   6. Internal emergency battery unit, with battery.
   7. Internal emergency transfer devices, without battery.
   8. External Emergency transfer devices.

B. Related Sections include the following:
   1. Division 26 Section "Network Lighting Controls" for low-voltage, manual and programmable lighting control systems.
   2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.
   3. Division 26 Section "Interior Lighting" for luminaires use in the interior of the building.

1.2 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.3 SUBMITTALS

A. Quality Assurance/Control Submittals:
   1. Product Data: For each type of product indicated.
   2. Field quality-control test reports.

1.4 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where title below introduces lists, the following requirement applies for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance only when allowed in Section 260050, General Electrical Requirements.

2.2 SINGLE CIRCUIT ELECTRONIC TIME SWITCHES

A. Manufacturers:
1. Intermatic, Inc. The following paragraph describes Intermatic model ET70415CR
2. Paragon Electric Co.; Invensys Climate Controls.
3. TORK

B. Description: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
1. Contact Configuration: Single Pole Double Throw SPDT.
2. Contact Rating: 20-A resistive/general purpose and 20-A ballast, 277-V ac.
3. Program: 7-day and full-year control, one circuit, 10 on/off set points, 99 holiday schedules, automatic day-light saving time adjustment.
4. Override Control: Circuit may be temporarily overridden for up to 4 hours when external momentary or maintained contact closure is actuated.
5. Astronomic Time
6. Battery Backup: For schedules and time clock

2.3 MULTI-CIRCUIT PROGRAMMABLE ELECTRONIC TIME SWITCHES

A. Manufacturers:
1. Intermatic, Inc.
2. Paragon Electric Co.; Invensys Climate Controls.
3. TORK

B. Description: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
1. Contact Configuration: Single Pole Double Throw SPDT.
2. Switch shall control a minimum of 6 circuits, unless additional circuits are shown on the drawings.
3. Contact Rating: 20-A resistive/general purpose and 20-A ballast, 277-V ac.
4. Program: 7-day and full-year control, 1000 on/off set points, 99 holiday schedules, automatic day-light saving time adjustment.
5. Override Control: Each channel or group of channels may be temporarily overridden for up to 4 hours when external momentary or maintained contact closure is actuated.
6. Load Control: Variable pulse and interval options.
7. Astronomic Time: All channels.
8. Battery Backup: For schedules and time clock.
9. Provide training for owner and initially program the unit to control all connected circuits.

2.4 ELECTROMECHANICAL-DIAL TIME SWITCHES

A. Manufacturers:
1. Intermatic, Inc.
2. Paragon Electric Co.; Invensys Climate Controls.
3. TORK.

B. Description: Type complying with UL 917.
1. Contact Configuration: SPST, DPST, SPDT, or DPDT as required for application.
2. Contact Rating: 40-A resistive, 277-V ac.
3. Skip-a-day mode.
4. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.
5. Astronomic time dial.

2.5 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers:
   1. Intermatic, Inc.
   2. Leviton Mfg. Co., Inc.; Lighting Control Division.
   3. Paragon Electric Co.; Invensys Climate Controls.
   4. TORK.

B. Description: Solid state, with SPST or DPST dry contacts as required for application, rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
   1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
   2. Time Delay: 15-second minimum, to prevent false operation.
   3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
   4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor.

2.6 LUMINAIRE-MOUNTED PHOTOELECTRIC SWITCHES

A. When specified on drawings, provide exterior luminaires with a internal photoelectric switch to de-energize the luminaire.

B. Comply with UL 773 or UL 773A.

C. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
   1. Relay with locking-type receptacle shall comply with NEMA C136.10.
   2. Adjustable window slide for adjusting on-off set points.

2.7 INDOOR OCCUPANCY SENSORS

A. Manufacturers:
   1. Hubbell Building Automation, Inc.
   2. Leviton Mfg. Co., Inc.; Lighting Control Division.
   3. Cooper Controls, Greengate Products; a Cooper Industries, Ltd. company.
   4. Sensor Switch, Inc.; an Acuity Brands company.

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit, complying with NEMA WD 7.
   1. Operation: Unless otherwise indicated, self adjusting to turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, manually adjustable over a minimum range of 1 to 15 minutes.
   2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
      a. Provide dry contact for integration with building management system in addition to contact required for lighting control.
   4. Mounting:
      a. Sensor: Suitable for mounting in any position on a standard outlet box.
      b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
      c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. PIR Type (Plan Type “CI”): Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. (Plan Type “CI”) 360 Degree Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1200 sq. ft. (min.) when mounted on a 96-inch- high ceiling.
3. (Plan Type “CI”)180 Degree Detection Coverage (Room): Detect occupancy anywhere in a half circular area of 1200 sq. ft. (min.) when mounted on a 96-inch- high ceiling. Provide with ceiling mounting bracket if not supplied as standard with sensor.

D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s .
2. (Plan Type “CU”): 360 Detection Coverage (Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
3. (Plan Type “xx”): 180 Detection Coverage (Room): Detect occupancy anywhere within a half circular area of 1200 sq. ft. (min.) when mounted on a 96-inch- high ceiling. Provide with ceiling mounting bracket if not supplied as standard with sensor.
4. (Plan Type “CO”) Detection Coverage (Corridor): Detect occupancy anywhere within 56’x16’ (min.) rectangular shaped coverage area when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.

E. Dual-Technology Type (Plan Type “CT”): Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in, and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s .
3. (Plan Type “CT”) 360 Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
4. (Plan Type “CT”) 180 Detection Coverage (Standard Room): Detect occupancy anywhere within a half circular area of 1200 sq. ft. (min.) when mounted on a 96-inch- high ceiling. Provide with ceiling mounting bracket if not supplied as standard with sensor

F. Wall Mounted PIR Type (Plan Type “WI”): Wall mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Detection Coverage: Detect occupancy anywhere in a 180 degree area of 1200 sq. ft. (min.) when mounted at 96-inches above finished floor.
3. Mounting: Articulating mounting base.

G. Wall Mounted Dual-Technology Type (Plan Type “WT”): Wall mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in, and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

3. Detection Coverage: Detect occupancy anywhere within a 180 degree area of 1200 sq. ft. (min.) when mounted at 96-inches above finish floor.
4. Mounting: Articulating mounting base.

H. Wall-Switch Sensors, Passive-Infrared Type (Plan Type “SI”):
1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 20 minutes, manual override switch, 180-degree field of view, with a minimum coverage area of 900 sq. ft., complying with NEMA WD 7.
2. Device color to match other supplied wiring devices. Refer to Division 26 Section “Wiring Devices” for requirements.

I. Wall-Switch Sensors, Dual Technology Type (Plan Type “ST”): :
1. Description: Adaptive-technology type, passive-infrared/ultrasonic type, 120/277 V, adjustable time delay up to 20 minutes, manual override switch, 180-degree field of view, with a minimum coverage area of 900 sq. ft., complying with NEMA WD 7. Sensor shall detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
2. Device color to match other supplied wiring devices. Refer to Division 26 Section “Wiring Devices” for requirements.

J. High Bay PIR Type (Plan Type “HB”): Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 36-foot diameter (min.) when mounted up to a 20-foot mounting height.

K. Power Pack: Self-contained power pack with transformer and relay (an ON/OFF switch controlled by a circuit) compatible with the supplied occupancy sensors designed for low-voltage 24 VDC occupancy sensors.
1. Universal voltage input (100–277 VAC; 50/60Hz).
2. Automatic voltage detection.
3. Electrical load switching capability: maximum of 20 Amps.
4. Regulated 24 VDC current; 150mA output; short circuit protected.
5. Zero Arc Point Switching.
6. Plenum rated.
7. Suitable for mounting inside or outside a junction box, or inside a ballast or driver cavity.
8. UL and cUL listed

2.8 OUTDOOR MOTION SENSORS (PIR)

A. Manufacturers:
1. Hubbell Building Automation, Inc.
2. Leviton Mfg. Co., Inc.; Lighting Control Division.
3. Cooper Controls, Greengate Products; a Cooper Industries, Ltd. company.
4. Sensor Switch, Inc.; an Acuity Brands company.

B. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as raintight according to UL 773A.
1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
2. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
   b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
3. Bypass Switch: Override the on function in case of sensor failure.
4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc ; keep lighting off during daylight hours.

C. Detection Coverage: Up to 35 feet, with a field of view of 180 degrees.

D. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   1. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
   2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

2.9 INDOOR DAYLIGHT SENSOR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Building Automation, Inc.
   2. Leviton Mfg. Co., Inc.; Lighting Control Division.
   3. Cooper Controls, Greengate Products; a Cooper Industries, Ltd. company.
   4. Sensor Switch, Inc.; an Acuity Brands company.

B. Ceiling-Mounted Daylight Sensors: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
   1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
   3. Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
   4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
   5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

C. Skylight Daylight Sensors: Solid-state, light-level sensor; housed in a threaded, plastic fitting for mounting under skylight, facing up at skylight; with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
   1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
   3. Light-Level Monitoring Range: 1000 to 10,000 fc, with an adjustment for turn-on and turn-off levels within that range.
   4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
   5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.10 LIGHTING CONTACTORS

A. Manufacturers:
   1. Allen-Bradley/Rockwell Automation.
   2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
   3. Eaton Electrical Inc.; Cutler-Hammer Products.
   4. Square D; Schneider Electric.

B. Description: Electrically operated and electrically held, complying with NEMA ICS 2 and UL 508.
   1. Current Rating for Switching: 30-A fluorescent lighting rating, 20-A tungsten lighting rating.
   2. Contacts: Two through 12 poles, field-convertible contacts.
   3. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.

4. Control Circuit: 120 or 277V Coil as shown on drawings: Provide integral control power transformer, with integral primary and secondary fusing. With sufficient capacity to operate connected load plus 100 percent spare capacity.
5. Enclosure: NEMA 250, Type 1.
6. Provide with the following control and pilot devices, matching the NEMA type specified for the enclosure:
    a. Hand/Off/Automatic selector switch in cover.
    b. Green pilot light to indicate contacts are energized.
    c. Nameplates for all devices

C. Description: Only when shown on drawings, electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: 30-A fluorescent lighting rating, 20-A tungsten lighting rating.
2. Contacts: Two through 12 poles, field-convertible contacts.
3. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
4. Control Circuit: 120 or 277V Coil as shown on drawings: Provide integral control power transformer, with integral primary and secondary fusing. With sufficient capacity to operate connected load plus 100 percent spare capacity.
5. Enclosure: NEMA 250, Type 1.
6. Provide with the following control and pilot devices, matching the NEMA type specified for the enclosure:
    a. Hand/Off/Automatic selector switch.
    b. Green pilot light to indicate contacts are energized.
    c. Nameplates for all devices
    d. Two-wire control relay.

2.11 EMERGENCY TRANSFER DEVICE (ETD), INTEGRAL TO LUMINAIRE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Cooper Lighting; Sure-Lites Division; a Division of Cooper Industries.
2. IOTA Engineering LLC.
3. McPhilben; a Philips group brand.
4. Philips Bodine.

B. Emergency Transfer Devices Integral to Luminaire: When the facility has an emergency generator, provide self-contained, modular, emergency transfer switch unit, factory mounted within luminaire body and compatible for either fluorescent ballast or solid-state lighting driver.
1. Comply with UL 924.
2. Provide 120 or 277 V, 60 Hz operation as required.
3. Provide painted steel or galvanized steel housing.
4. Provide temperature rating from 32 deg F to 122 deg F.
5. Provide device rated 2.0 W AC input power and 280 mA AC input current or less during normal operation.
6. Provide device capable of switching 3 amps, minimum, electronic fluorescent or incandescent load at 120 V or 277 V.
7. Provide 3 A overcurrent protection of control circuit input and switched load circuit.
8. Normal Mode Operation: Normal AC power is present. AC ballast or solid-state lighting driver operates fluorescent or LED lamp(s) as intended, controlled by wall switch.
9. Emergency Mode Operation: Normal AC power fails. Emergency transfer device senses normal AC power failure and automatically switches to emergency AC power, bypassing wall switch. When normal AC power is restored, emergency transfer device switches system back to normal mode operation.
10. Provide one device per emergency luminaire, unless otherwise indicated.

2.12 EMERGENCY BATTERY PACK (EBP), INTEGRAL TO LUMINAIRE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Cooper Lighting; Sure-Lites Division; a Division of Cooper Industries.
2. Dual-Lite; a Division of Hubbell Lighting, Inc.
3. IOTA Engineering LLC.
4. Lithonia Lighting; a Division of Acuity Lighting Group, Inc.
5. McPhilben; a Philips group brand.
6. Philips Bodine.

B. Emergency Battery Unit Integral to Luminaire: Provide self-contained, modular, emergency transfer switch unit, with battery-inverter unit, factory mounted within luminaire body and compatible for either fluorescent ballast or solid-state lighting driver. When used on luminaire mounted exterior of the building, they shall be suitable for temperatures from minus 4 deg F to plus 140 deg F.
1. Comply with UL 924
2. Provide 120 or 277 V, 60 Hz operation as required.
3. Emergency Connection: Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast or driver.
    a. LED: 32 W, 30 V dc, 200 mA

4. Night-Light Connection: Operate one fluorescent lamp or LED module continuously.
5. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Battery: Sealed, maintenance-free, nickel-cadmium type.
7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.13 REMOTE EMERGENCY TRANSFER DEVICE (RTD), REMOTE FROM LUMINAIRE TO CONTROL A WHOLE CIRCUIT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Watt Stooper.
2. Philips Bodine
3. McPhilben; a Philips group brand.

B. Whole Circuit Emergency Transfer Devices: When the facility has an emergency generator, provide a field mounted, emergency transfer switch unit, adjacent to emergency panel as shown on drawings.
1. Comply with UL 924.
2. Provide 120 or 277 V, 60 Hz operation as indicated.
3. Provide threaded hub to attach to electrical box.
4. Provide temperature rating from minus 4 deg F to 131 deg F.
5. Provide device capable of switching 20 amps, minimum, electronic fluorescent or incandescent load.
6. LED lamp(s) as intended shall display Normal Mode Operation: Normal AC power is present. AC load controlled by wall switch.
7. LED lamp(s) as intended shall display Emergency Mode Operation: Normal AC power fails. Emergency transfer device senses normal AC power failure and automatically switches to emergency AC power, bypassing wall switch. When normal AC power is restored, emergency transfer device switches system back to normal mode operation.

8. Unswitched Mode Operation: LED lamp(s) as intended shall display Emergency luminaires are normal off. Normal AC power fails. Emergency transfer device senses normal AC power failure and automatically switches power to energize emergency luminaires. This is accomplished by not connecting a conductor to the wall switch terminal on the unit. When normal AC power is restored, emergency transfer device switches emergency luminaires off.
9. Provide external push to test button.
10. Provide one device per each emergency circuit, unless otherwise indicated.

2.14 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Provide occupancy sensors, power packs, and all associated accessories, backboxes, conduit, wiring, etc. for a complete installation of occupancy sensor controlled lighting for rooms indicated as requiring occupancy sensor control on the Drawings

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

C. Occupancy Adjustments: Adjust each sensor to suit occupied conditions. Adjust time delay on all occupancy sensors to its maximum setting, 30 minutes or longer. Adjust sensitivity to quickly pick up motion or presence of a person. Coordinate any required adjustments of occupancy sensors (as applicable for selected manufacturer) with the Owner and make any adjustments as directed.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

E. Wire occupancy sensors per manufacturer’s recommendations to allow for both sensor and manual control of lighting as indicated on the Drawings.

F. Power packs shall be provided in the quantity required to serve occupancy sensor(s) with the switching and branch circuiting schemes indicated on the Drawings. Power pack locations/quantities are not indicated on the Drawings. Power packs shall be plenum rated. Install power pack on local branch circuit junction box serving local area lighting.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: DO NOT SPLICE LOW VOLTAGE CONDUCTORS OUTSIDE OF A BOX. Make all connections only in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Terminate on numbered terminal strips or use wire nuts if terminal strips are not available.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
   2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.5 ADJUSTING

A. Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the angle of any luminaire that had not been properly aimed. Provide up to one visit to Project during the evening hours for this purpose.

B. Adjust all Photoelectric switches so that they are not directed toward artificial light source which will provide a false off signal. Aim all devices toward the North sky exposure. Calibrate so that they will only energize luminaire in darkness of 1.5 to 3 footcandles.

END OF SECTION 26 09 23

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
   1. Distribution transformers.

1.2 SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring.

B. Quality Assurance/Control Submittals:
   1. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
   2. Source quality-control test reports.
   3. Field quality-control test reports.

1.3 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where title below introduces lists, the following requirement applies for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance only when allowed in Section 260050, General Electrical Requirements.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.
   1. Internal Coil Connections: Brazed or pressure type.
   2. Coil Material: Aluminum or copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Manufacturers:
   1. ACME Electric Corporation; Power Distribution Products Division.
   2. Eaton Corporation; Cutler-Hammer Products.
   3. Federal Pacific Transformer Company; Division of Electro-Mechanical Corporation.
   4. Hammond Co.; Matra Electric, Inc.
   5. Jefferson Electric.
   6. Siemens Energy & Automation, Inc.
   7. Sola/Hevi-Duty.
   8. Square D; Schneider Electric.

B. Comply with NEMA ST 20 and list and label as complying with UL 1561.

C. Cores: One leg per phase.

D. Indoor Enclosure: Ventilated, NEMA 250, Type 2.

E. Outdoor Enclosure: Ventilated, NEMA 250, Type 3R.
   1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

F. Taps for Transformers Smaller Than 3 kVA: None.

G. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

I. Insulation Class for Transformers Rated 14 kVA and Smaller: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

J. Insulation Class for Transformers Rated 15 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

K. Wall Brackets: Manufacturer's standard brackets.

L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

M. Terminal Boards: Provide top or bottom mounted terminal boards for transformers rated 25 kVA and larger. Loose leads are not acceptable.

N. Equipment lugs: Provide a mechanical ground lug to the transformer enclosure. In addition, provide a separate ground bar inside the transformer enclosure from termination of all grounding conductors. Refer to grounding details on drawings for location of neutral bonding jumper and method of installation for separately derived systems.

O. Three-Phase Transformer Minimum Impedance Requirements, Percent Z:
1. 15 kVA: 5.0.
2. 30 kVA: 4.9.
3. 45 kVA: 4.8.
4. 75 kVA: 4.4.
5. 112.5 kVA: 3.9.
6. 150 kVA: 4.4.
7. 225 kVA: 3.9.
8. 300 kVA: 5.5.
9. 500 kVA: 6.0.
10. 750 kVA: 5.4.

2.4 TRANSFORMER SURGE PROTECTIVE DEVICE

A. On all transformers, 45KVA and above, provide a surge protective device.

B. The surge protective device shall be 3 phase with neutral and ground conductor leads. (High Energy), MOV, low-voltage distribution-class surge arrester, designed to provide surge protection at distribution transformer secondary bushings. Externally mounted with thread hud. Conductor leads must be as short as possible.

C. The surge protective device must pass all design tests for light duty distribution class arresters per IEEE Std C62.11™ -1993 standard.

D. Manufacturer shall be Cooper Power Systems Storm Trapper H.E. The Storm Trapper H.E. or Engineer approved equal.

2.5 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 409.

B. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
   1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems.

C. Install and anchor floor-mounting transformers level on concrete bases, 4-inch nominal thickness. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
   2. For floor-mounting transformers, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to floor-mounting transformers.

D. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower

than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.
   3. Surge suppression panelboards.

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

1.3 SUBMITTALS

A. Shop Drawings: For each panelboard and related equipment.
   1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details for types other than NEMA 250, Type 1.
      b. Bus configuration, current, and voltage ratings.
      c. Short-circuit current rating of panelboards and overcurrent protective devices.
      d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   2. Wiring Diagrams: Power, signal, and control wiring.

B. Quality Assurance/Control Submittals:
   1. Product Data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
   2. Field quality-control test reports including the following:
      a. Test procedures used.
      b. Test results that comply with requirements.
      c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
   3. Panelboard Schedules: For installation in panelboards.

1.4 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
      a. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
      b. Time-current curves, including selectable ranges for each type of overcurrent protective device.
   2. Extra Materials: Receipt for extra materials.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: Not exceeding 104 deg F.
   2. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

A. Special Warranty for Surge Protective Devices: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 5 years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. Siemens Energy & Automation, Inc.
   3. Square D; Schneider Electric.

B. Products of other manufacturers will be considered for acceptance only when allowed in Section 260050, General Electrical Requirements.

2.2 MANUFACTURED UNITS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1.
   1. Rated for environmental conditions at installed location.
      a. Outdoor Locations: NEMA 250, Type 3R.
      b. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
      c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
   3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
   4. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
   5. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

C. Phase and Ground Buses:
   1. Material: Hard-drawn copper, 98 percent conductivity; or tin-plated aluminum.
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
   3. Split Bus: Vertical buses divided into individual vertical sections.

D. Conductor Connectors: Suitable for use with conductor material.
   1. Main and Neutral Lugs: Mechanical type.
   2. Ground Lugs and Bus Configured Terminators: Mechanical type.
   3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

E. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Short-Circuit Current Rating: Refer to drawings for RMS symmetrical, ampere AIC ratings.
   1. Series-connected ratings are not permitted.

2.4 DISTRIBUTION PANELBOARDS

A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

B. Main Overcurrent Protective Devices: Circuit breaker or fused switch as indicated.

C. Branch Overcurrent Protective Devices: One of the following as indicated:
   1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
   2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
   3. Fused switches

D. Circuit Identification: Distribution panelboards shall have each circuit number permanently identified, factory installed label, adjacent to breaker. Identification shall stamped into trim or installed engraved circuit numbers or paper labels. If paper labels are used, they must be covered with a continuous, clear, self adhesive, protective plastic sheet.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

B. Main Overcurrent Devices: Thermal-magnetic circuit breaker.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Circuit Identification: Panelboards shall have each circuit number permanently identified, factory installed label, adjacent to breaker. Identification shall stamped into trim or installed engraved circuit numbers or paper labels. If paper labels are used, they must be covered with a continuous, clear, self adhesive, protective plastic sheet.

2.6 SURGE SUPPRESSION PANELBOARDS

A. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

B. Main Overcurrent Devices: Thermal-magnetic circuit breaker.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Surge Protective Device: IEEE C62.41, integrally mounted, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.
   1. Maximum Continuous Operation Voltage (MCOV) Rating: Not less than 115 percent of nominal system operating voltage.
   2. UL 1449 Application Designation: Type 1 or Type 2.
   3. Short-Circuit Current Rating (SCCR): 100,000 A RMS symmetrical.
   4. Nominal Discharge Current (In) Rating: 20 kA.
   5. LED indicator lights for power and protection status.
   6. Audible alarm activated on failure of any surge diversion module.
   7. Minimum Single-Impulse Current Ratings:
      a. Line to Neutral: 50,000 A.
      b. Line to Ground: 50,000 A.
      c. Neutral to Ground: 50,000 A.
   8. Protection modes shall be as follows:
      a. Line to neutral.
      b. Line to ground.
      c. Neutral to ground.
   9. Maximum UL 1449 voltage protection rating (VPR) shall not exceed 700 V, line to neutral and line to ground on 120/208 V systems; 1200 V, line to neutral and line to ground on 277/480 V systems.
   10. Provide integrally mounted three pole disconnecting device with overcurrent protection properly sized for the SPD provided.

2.7 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

D. Fuses are specified in Division 26 Section "Fuses."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 407.

B. Install panelboards and accessories according to NEMA PB 1.1.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Mount top of trim 74 inches above finished floor, unless otherwise indicated.

E. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

F. Install overcurrent protective devices and controllers.
1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Install filler plates in unused spaces.

H. Flush Panelboards: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

J. Panelboards shall not be used as junction boxes, auxiliary gutters, or raceways for conductors feeding through or tapping off to other switches or overcurrent devices. Splices shall not be allowed in any panelboard. Phase conductors shall terminate on breakers and then leave the panelboard either grouped in three phase configuration or with associated neutrals and routed into the branch circuit conduit out to the load.

3.2 IDENTIFICATION

A. Refer to Division 260533 Section "Identification for Electrical Systems." Provide all identification for field-installed conductors in panels, labels, nameplates, warning signs, etc. including, but not limited to:
1. Equipment Identification Label
2. Nominal System Voltage Identification Label
3. Electrical Energy Source Identification Label
4. Panelboards shall have circuit Directories
5. Distribution Panelboards shall have Load Identification Labels for each Feeder and Branch Circuit

B. Provide Factory installed nameplates.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Repair exposed surfaces to match original finish.

B. Vacuum interior of panels to remove dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Twist-locking receptacles.
   3. Snap switches and wall-box dimmers.
   4. Wall-switch occupancy sensors.
   5. USB charging outlets
   6. Spring-wound interval time switches.
   7. Cord reels.
   8. Pendant cord-connector devices
   9. Drop Cords
   10. Cord and plug sets.

B. Related Sections include the following:
   1. Division 26 Section "Conduit and Boxes for Electrical Systems" for conduit, metal and nonmetallic floor boxes, poke through service fitting, high capacity floor boxes, etc.
   2. Division 26 Section "Surface Raceways for Electrical Systems" for surface raceways, wireways, multioutlet assemblies, service poles, etc.
   3. Division 26 Section "Lighting Control Devices" for photoelectric switches and occupancy sensors other than wall-switch type.
   4. Division 27 Section "Communications Copper Horizontal Cabling" for workstation outlets.

1.2 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.3 SUBMITTALS

A. Quality Assurance/Control Submittals:
   1. Product Data: Provide product data sheet for each wiring device or product in this Section and on the Drawings that are specifically applicable to this project. Provide an arrow stamp pointing to the exact catalog number or product and do not merely highlight the information.
   2. For special purpose NEMA type receptacles, Submittal shall indicate equipment served for each special purpose receptacle type (e.g. NEMA 15-50R-- “Kiln”).
   3. Field quality-control test reports.

1.4 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
   1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Arrow Hart/Cooper Wiring Devices; a division of Cooper Industries, Ltd. (Arrow Hart).
   2. Hubbell Incorporated; Bryant Electric (Bryant).
   3. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   4. Leviton Mfg. Co., Inc. (Leviton).
   5. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

B. Products of other manufacturers will be considered for acceptance only when allowed in Section 260050, General Electrical Requirements

C. All wiring devices in this building shall be supplied from the same manufacturer. Use of multiple manufactures of wiring devices in the same building is not allowed.

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, DSCC W C 596G, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Arrow Hart; 5361 (single), AH5362 (duplex).
      b. Bryant; 5361 (single), BRY5362 (duplex).
      c. Hubbell; HBL5361 (single), HBL5362 (duplex).
      d. Leviton; 5361 (single), 5362 (duplex).
      e. Pass & Seymour; 5361 (single), 5362-A (duplex), PT5362A (duplex, with separable pigtailed connector).

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Arrow Hart; TR8300.
      b. Bryant; BRY8300TR.
      c. Hubbell; HBL8300SG.
      d. Leviton; 8300-SG.
      e. Pass & Seymour; TR63H, or PTR63H (with separable pigtailed connector).
   2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

C. Residential Electric Clothes Dryer Receptacles, 125/250 V, 30 A: Comply with NEMA WD 1, NEMA WD 6 configuration 14-30R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Arrow Hart; 1257.
      b. Bryant; 9430FR.
      c. Hubbell; HBL9430A.
      d. Leviton; 278.
      e. Pass & Seymour; 3864.

D. Residential Electric Oven/Range Receptacles, 125/250 V, 50 A: Comply with NEMA WD 1, NEMA WD 6 configuration 14-50R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:

a. Arrow Hart; 1258.
b. Bryant; 9450FR.
c. Hubbell; HBL9450A.
d. Leviton; 279.
e. Pass & Seymour; 3894.

E. Clock Hanger Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-15R, DSCC W C 596G, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Arrow Hart; 93632.
b. Bryant; 2828GS.
c. Hubbell; HBL5235.
d. Leviton; 5261-CH.
e. Pass & Seymour; S3733-SS.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Arrow Hart; VGF20.
b. Bryant; GF20L.
c. Hubbell; GF20L.
d. Leviton; 7899.
e. Pass & Seymour; 2095, or PT2095 (with separable pigtailed connector).

C. Listed Weather-Resistant Type Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Arrow Hart; WRVGF20.
b. Hubbell; GFTR20.
c. Pass & Seymour; 2095-TRWR.

D. Tamper-Resistant Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Arrow Hart; TRVGF20.
b. Hubbell; GFTR20.
c. Leviton; T7899.
d. Pass & Seymour; 2095-TR, or PT2095-TR (with separable pigtailed connector).

2.4 DUPLEX RECEPTACLE WITH USB CHARGER.

A. Duplex Convenience Receptacles, 125 V, AC, 20 A with USB Charger, Tamper-Resistant: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Arrow Hart; TR7746.
b. Bryant; USBB20.
c. Hubbell; USB20X2.
d. Pass & Seymour; TR5362USB.

B. Description: duplex receptacle with two USB Type 2.0 ports, Type A rated 3.0 Amps (minimum) at 5 Volts DC, integral AC/DC transformer, compatible with USB 2.0/3.0 devices, compliance with battery charging specification USB BC1.2, capable of charging two devices simultaneously. Decorator style thermoplastic body and tamper resistant sliding doors will prohibit insertion of objects that are not an electrical plug. Provide device in color to match other supplied wiring devices.

2.5 USB CHARGER STATIONS

A. USB Charger Station:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Arrow Hart; 7750.
      b. Bryant; USBB20.
      c. Hubbell; USB20X2.
      d. Pass & Seymour; TMBUSB4WCC6.

B. Description: USB charger, with four USB Type 2.0 ports, Type A rated 5.0 Amps (minimum) at 5 Volts DC, integral AC/DC transformer, compatible with USB 2.0/3.0 devices, compliance with battery charging specification USB BC1.2, capable of charging multiple devices simultaneously. Decorator style thermoplastic body. Provide device in color to match other supplied wiring devices.

2.6 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 15 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-15R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Bryant; 4710.
      b. Arrow Hart; CWL515R.
      c. Hubbell; HBL4710.
      d. Leviton; 4710.
      e. Pass & Seymour; L515-R.

B. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Arrow Hart; CWL520R.
      b. Bryant; 70520FR.
      c. Hubbell; HBL2310.
      d. Leviton; 2310.
      e. Pass & Seymour; L520-R.

C. Single Convenience Receptacles, 125 V, 30 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-30R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Arrow Hart; CWL530R.
      b. Bryant; 70530FR.
      c. Hubbell; HBL2610.
      d. Leviton; 2610.
      e. Pass & Seymour; L530-R.

2.7 SNAP SWITCHES

A. Comply with NEMA WD 1, DSCC W C 896F, and UL 20.

B. Switches, 120/277 V, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Arrow Hart; AH1221 (single pole), AH1222 (two pole), AH1223 (three way), AH1224 (four way).
      b. Bryant; 4901 (single pole), 4902 (two pole), 4903 (three way), 4904 (four way).
      c. Hubbell; HBL1221 (single pole), HBL1222 (two pole), HBL1223 (three way), HBL2224 (four way).
      d. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
      e. Pass & Seymour; PS20AC1 (single pole), PS20AC2 (two pole), PS20AC3 (three way), PS20AC4 (four way).

C. Pilot Light Switches, 20 A:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Arrow Hart; AH1221PL for 120 V and 277 V.
      b. Bryant; 4901PLR120 for 120 V, 4901PLR277 for 277 V.
      c. Hubbell; HBL1221PL for 120 V and 277 V.
      d. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
      e. Pass & Seymour; PS20AC1-RPL for 120 V, PS20AC1-RPL7 for 277 V.
   2. Description: Single pole, with red neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A; with factory-supplied key in lieu of switch handle.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Arrow Hart; AH1221L (single pole), AH1222L (two pole), AH1223L (three way), AH1224L (four way).
      b. Bryant; 4901-L (single pole), 4902-L (two pole), 4903-L (three way), 4904-L (four way).
      c. Hubbell; HBL1221L (single pole), HBL1222L (two pole), HBL1223L (three way), HBL1224L (four way).
      d. Leviton; 1221-2L (single pole), 1222-2L (two pole), 1223-2L (three way), 1224-2L (four way).
      e. Pass & Seymour; PS20AC1-L (single pole), PS20AC2-L (two pole), PS20AC3-L (three way), PS20AC4-L (four way).

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Arrow Hart; 1995.
      b. Bryant; 4921.
      c. Hubbell; HBL1557.
      d. Leviton; 1257.
      e. Pass & Seymour; 1251.

F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Arrow Hart; 1995L.
      b. Bryant; 1921-L.
      c. Hubbell; HBL1557L.
      d. Leviton; 1257-L.
      e. Pass & Seymour; 1251L.

2.8 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cooper Crouse-Hinds.
      b. EGS/Appleton Electric.
      c. Killark; a division of Hubbell Inc.

2.9 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slide type ~~rotary knob~~; with single-pole or three-way switching. Comply with UL 1472.

C. Contractor shall verify voltage and lamp source for the luminaire that is to be dimmed. Select from the following options and provide the matching required wall dimmer.

1. For L. E. D. luminaires: 0 to 10 volt dimmers for solid state luminaires. Verify the maximum quantity of luminaires in each space that can be controlled from one dimmer. Provide each space with the required quantity of dimmers to control all luminaires in that space.

2.10 SPRING-WOUND INTERVAL TIME SWITCHES

A. Single-gang, wall box spring-wound, auto-off timer:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Intermatic Incorporated, FF60MHC.
      b. Paragon Electrical Products, SWP60M.
      c. Tork, C560M.
   2. Description: 0 to 60 minute time cycle, brushed stainless steel or aluminum faceplate with coordinated time dial and knob.
   3. Electrical Ratings:
      a. Inductive: 20 A, 125 VAC; 10 A, 277 VAC.
      b. Tungsten: 7 A, 125 VAC.
      c. Motor: 1 HP, 125 VAC.

2.11 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: 0.035-inch- thick, medium size, satin-finished stainless steel.
   3. Material for Unfinished Spaces: Galvanized steel.
   4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.12 CORD REELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. EGS Electrical Group; McGill products.
   2. Industrial Electric Reels, Inc.
   3. Reelcraft Industries, Inc.
   4. Daniel Woodhead; a Woodhead Industries, Inc. Co.

B. Description: 115 V, 35 A, 60 Hz, spring retractable electric cord reel with latch, solid steel construction, abrasion and corrosion resistant baked on powder coat finish, nylon roller cable guides, adjustable cord stop, under-hung ceiling mounted.
   1. Provide 25 foot cord with No. 10 AWG stranded-copper conductors, rubber insulated, Type SO jacket, with green insulated grounding conductor, unless otherwise indicated.
   2. Provide two GFCI duplex receptacles, unless otherwise indicated.
   3. Provide cast aluminum or non-metallic portable outlet box, listed and labeled for “wet locations.”
   4. External Cable Grip: Provide woven wire-mesh, cord strain relief grip, made of high-strength galvanized-steel wire strand, matched to cable diameter and with corresponding attachment connector, and the device end.

2.13 PENDANT CORD-CONNECTOR DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. EGS Electrical Group; McGill products.
   2. Industrial Electric Reels, Inc.
   3. Reelcraft Industries, Inc.
   4. Daniel Woodhead; a Woodhead Industries, Inc. Co..

B. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R unless otherwise indicated, heavy-duty grade.
   1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
   2. External Cable Grip: Provide woven wire-mesh, cord strain relief grip, made of high-strength galvanized-steel wire strand, matched to cable diameter and with corresponding attachment connector, and each end.

2.14 DROP CORDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. EGS Electrical Group; McGill products.
   2. Industrial Electric Reels, Inc.
   3. Reelcraft Industries, Inc.
   4. Daniel Woodhead; a Woodhead Industries, Inc. Co.

B. Description: where shown on drawings, receptacles installed in cast metal boxes with stainless steel cover plates shall be used. A 3 conductor #12 AWG, type SJO cord shall be used, unless noted otherwise. Provide a stamped steel box above, at ceiling or in joist space, securely fastened to building steel. Outlet mounting height shall be 6’ – 6” unless noted otherwise.
   1. External Cable Grip: Provide woven wire-mesh, cord strain relief grip, made of high-strength galvanized-steel wire strand, matched to cable diameter and with corresponding attachment connector, and each end.

2.15 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
   1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
   2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection..

2.16 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color. Color as defined by NEMA WD 1 unless otherwise indicated.
   1. Wiring Devices Connected to Normal Power System: Gray, unless otherwise indicated or required by NFPA 70 or device listing.
   2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Coordination with Other Trades:
   1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
   1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
   4. Existing Conductors:
      a. Cut back and pigtail, or replace all damaged conductors.
      b. Straighten conductors that remain and remove corrosion and foreign matter.
      c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
   1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
   3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
   4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
   5. Connect grounding terminals of devices to device box and equipment grounding conductor using pigtails that are not less than 6 inches in length with factory-crimped flanged spade and ring terminals.
   6. When using side wiring with binding-head screw terminals, use solid conductor pigtails. Wrap conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
   7. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
   8. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
   9. Tighten unused terminal screws on the device.
   10. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
   11. Install device boxes so that finish plates do not span different types of building finishes.

E. Receptacle Orientation:
   1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates:
   1. Install blank device plates on unused device boxes.
   2. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening. Do not use oversized or extra-deep plates, unless approved by engineer.

G. Dimmers:
   1. Install dimmers within terms of their listing.
   2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Install devices into floor service outlets, service poles, and high capacity floor boxes to suit arrangement of partitions and furnishings.

J. Securely install multioutlet assemblies with screws and anchors. Comply with Division 26 Section "Hangers and Supports for Electrical Systems."

K. GFCI Receptacles: Where double-duplex GFCI receptacles are indicated, provide one duplex GFCI receptacle and feed-through to standard straight blade convenience receptacle in same device box.

1. Unless indicated otherwise, do not feed-through to receptacles in other device boxes.

L. Mounting Heights: Refer to drawings for mounting heights. If heights are not shown on drawings, install as follows. Measured from finished floor to bottom of outlet or device box, unless indicated otherwise.
   1. General Use Receptacles: 16 inches.
   2. Snap Switches, Wall-Box Dimmers, Wall-Switch Sensors: 44 inches.
      a. Install on strike side of door, 6 to 12 inches from door, unless otherwise indicated.
   3. Receptacles in Mechanical and Electrical Equipment Rooms: 48 inches.
   4. Wiring Devices Above 30-Inch-High Countertops: 40 inches.
      a. Install at least 2 inches above backsplash.
   5. Wiring Devices Above 36-Inch-High Countertops: 44 inches.
      a. Install at least 2 inches above backsplash.
   6. Wiring Devices Above 42-Inch-High Countertops: 48 inches.
      a. Install at least 2 inches above backsplash.
   7. Wiring Devices Above Lavatories: 44 inches.
   8. Receptacles Serving Domestic Refrigerators: 56 inches.
   9. Receptacles Serving Domestic Electric Clothes Dryers and Washing Machines: 32 inches.
   10. Receptacles Serving Domestic Dishwashers: 2 inches.
      a. Install horizontally.
   11. Recessed Motor Controls: 56 inches.
   12. Pushbuttons: 44 inches.
   13. Interior Wall Mounted Luminaire Outlets: 88 inches.
      a. Install at least 2 inches above mirrors.
   14. Occupant Adjustable Thermostats: 44 inches.
   15. Sensor Only Thermostats: 56 inches.
   16. Fire Alarm Manual Stations: 44 inches.
      a. Install within 5’-0” of door.
      b. Install no higher than 48 inches to top of device.
   17. Fire Alarm Notification Appliances: 80 inches, or 6 inches below ceiling. Whichever is lower.

M. Utilization Equipment: Refer to Shop Drawings for mounting height of special purpose devices serving, but not limited to, the following:
   1. Commercial kitchen equipment.
   2. Commercial clothes washers and dryers.
   3. Drinking water coolers.
   4. Sensor operated wash fountains and lavatories.

3.2 IDENTIFICATION

A. Comply with Division 26 05 53 Section "Identification for Electrical Systems" for the following:
   1. Receptacles: Identify panelboard and circuit number from which each receptacle is served
   2. Provide external, manufacturers adhesive label outside of cover plate when a standard receptacle is served from an upstream GFI device

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports. Refer to Division 26 Section “Electrical Testing” for requirements.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Cartridge fuses rated 600 V and less.

1.2 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
      a. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
         1) Let-through current curves for fuses with current-limiting characteristics.
         2) Time-current curves, coordination charts and tables, and related data.
   2. Extra Materials: Receipt for extra materials.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA FU 1.

D. Comply with NFPA 70.

1.4 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.5 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Quantity equal to 10 percent of each fuse type and size, but no fewer than 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Bussman, Inc.
   2. Mersen; (previously Ferraz Shawmut).
   3. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

B. Products of other manufacturers will be considered for acceptance only when allowed in Section 260050, General Electrical Requirements.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Service Entrance: Class L, time delay.

B. Feeders: Class L, time delay; or Class J, time delay.

C. Motor Branch Circuits: Class RK1, time delay.

D. Other Branch Circuits: Class J, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers.
   4. Molded-case switches.
   5. Enclosures.

1.2 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. HD: Heavy duty.

C. SPDT: Single pole, double throw.

1.3 SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

B. Quality Assurance/Control Submittals:
   1. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
      a. Enclosure types and details for types other than NEMA 250, Type 1.
      b. Current and voltage ratings.
      c. Short-circuit current rating.
      d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   2. Field quality-control test reports including the following:
      a. Test procedures used.
      b. Test results that comply with requirements.
      c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
   1. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
      a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
      b. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
   2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance only when allowed in Section 260050, General Electrical Requirements.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. Siemens Energy & Automation, Inc.
   3. Square D; Schneider Electric.

B. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position. Provide fuses, sized as shown on drawings. Switches shall be two or three pole. Refer to Plan Drawings for location of the following sizes.
   1. 30 A, 60 A, 100 A, 200 A, 400 A, 600 A, 800 A, or 1200 A

C. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position. Switches shall be two or three pole. Refer to Plan Drawings for location of the following sizes.
   1. 30 A, 60 A, 100 A, 200 A, 400 A, 600 A, 800 A, or 1200 A

D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
   3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MANUAL FUSIBLE STARTING SWITCHES

A. Manufacturers:
   1. Cooper Bussman, Inc.
   2. Ferraz Shawmut, Inc.

3. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

B. Description: Box cover units for standard electrical boxes with fused outlet or fused switch protection, Type S dual-element fuse and screw in fuse holder, rated 1/2 horsepower. Provide fuses, sized as shown on drawings. Switches shall be single or two pole. Refer to Plan Drawings for location of the following sizes.
   1. Single pole NEMA WD 6 configuration with a 5-15R receptacle in box.
   2. Single-pole snap switch.

2.4 FUSED POWER CIRCUIT DEVICES

A. Bolted-Pressure Contact Switch: UL 977; operating mechanism shall use a rotary-mechanical-bolting action to produce and maintain high-clamping pressure on the switch blade after it engages the stationary contacts.
   1. Manufacturers:
      a. Boltswitch, Inc.
      b. Pringle Electrical Mfg. Co.
      c. Square D; Schneider Electric.
   2. Main Contact Interrupting Capability: Twelve times the switch current rating, minimum.
   3. Operating Mechanism: Manual handle operation to close switch stores energy in mechanism for closing and opening.
   4. Auxiliary Switches: Factory installed, SPDT, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
   5. Service-Rated Switches: Labeled for use as service equipment.
   6. Ground-Fault Relay: Comply with UL 1053. Self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
      a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground fault indicator.

2.5 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. Siemens Energy & Automation, Inc.
   3. Square D; Schneider Electric.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents. Breakers shall be two or three pole. Refer to Plan Drawings for location of the following sizes.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

C. Molded-Case Circuit-Breaker Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical stylesuitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
      a. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.
   6. Shunt Trip: [**208-V**] [**240-V**] [**277-V**] trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

E. Molded-Case Switch Accessories:
   1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
   2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage. Provide "dummy" trip unit where required for proper operation.
      a. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.
   4. Shunt Trip: [**208-V**] [**240-V**] [**277-V**] trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

2.6 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
   1. General purpose locations: Nema 1
   2. Outdoor Locations: NEMA 250, Type 3R.
   3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
   4. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   5. Heavy Industrial locations: Nema 12

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

3.3 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to 3 inch high concrete housekeeping pads.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:
   1. Inspect mechanical and electrical connections.
   2. Verify switch and relay type and labeling verification.
   3. Verify rating of installed fuses.
   4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

B. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 26 28 16

SECTION 26 51 00 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:
   1. Interior luminaires, lamps, ballasts, and solid-state lighting drivers.
   2. Exterior luminaires normally mounted on exterior surfaces of buildings.
   3. Emergency lighting units.
   4. Exit signs.
   5. Luminaire supports.

B. Related Sections include the following:
   1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, emergency transfer devices and multipole lighting relays and contactors.
   2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.2 DEFINITIONS

A. BF: Ballast factor.

B. CEE: Consortium for Energy Efficiency, Inc.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LED: Light-emitting diode.

F. LER: Luminaire efficacy rating.

G. Luminaire: Complete lighting fixture, including ballast and driver housing if provided.

H. SSL: Solid-state lighting.

1.3 SUBMITTALS

A. Quality Assurance/Control Submittals:
   1. Product Data: For each type of luminaire, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
      a. Physical description of lighting fixture including dimensions.
      b. Emergency lighting units including battery and charger.
      c. Ballast and solid-state lighting Drivers. Submit product data sheets marked or highlighted for the specific ballast or solid-state lighting driver manufacturers/models for applicable products being provided from Part 2 of this Section ”Generic” or “manufacturers choice” ballasts or solid-state lighting drivers are not acceptable. Submittals missing this information will be Rejected.
      d. Energy-efficiency data.
      e. Life, output, energy-efficiency data, and mercury content for lamps. Submit product data sheets marked or highlighted for the lamp manufacturer/models for applicable products being provided from Part 2 of this Section. Submittals missing this information will be Rejected.
      f. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, solid-state lighting drivers, and accessories identical to those indicated for the lighting fixture as applied in this Project.

1) Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

2. Field quality-control test reports.

1.4 CLOSEOUT DOCUMENTS

A. General: Closeout Submittals are to be submitted with O and M Manuals only. Do not submit with other ACTION and INFORMATIONAL Submittals:
1. Operation and Maintenance Data: For lighting equipment and fixtures to include in operation and maintenance manuals.
2. Warranties: Special warranties specified in this Section.
3. Extra Materials: Receipt for extra materials.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for solid-state lighting Luminaires and solid-state lighting Drivers: Manufacturer's standard form in which manufacturer of lighting unit agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Solid-state lighting Luminaires and Solid-State Lighting Drivers: 5 years from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
2. Warranty Period for Emergency Fluorescent Ballast and Emergency Solid-State Lighting Drivers and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Battery and Charger Data: One for each emergency lighting unit.

4. Ballasts and Solid-State Lighting Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.
6. LED Packages, Arrays and Modules: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In the Luminaire Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance only when allowed in Section 260050, General Electrical Requirements.

2.2 LUMINAIRES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. LED Fixtures: Comply with UL 1598, in addition to the requirements contained in UL Subject 8750.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.

G. Plastic Diffusers, Covers, and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch nominal unless different thickness is indicated.
      b. UV stabilized.
   2. Glass: Annealed crystal glass, unless otherwise indicated.

H. Trim Work: Provide solid aluminum or solid brass bar work, finials, and similar trim on wall sconces and decorative pendent lighting fixtures. Steel or hollow tubes are not permitted.

I. Tap Connections (Fixture Whips): Not longer than 6 feet, constructed of No. 12 AWG copper conductors.

2.3 DRIVERS FOR SOLID-STATE LIGHTING LUMINAIRES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Sylvania.
2. Philips Lighting Co.
3. EldoLED (Acuity Brand).
4. Energy Recovery Products (Cooper Brand).
5. Thomas Research Products (Hubbell Brand).
6. Lutron (1% dimming).

B. Electronic Drivers: Comply with ANSI C82.11, NEMA SSL 1, and UL 935 in addition to the requirements contained in UL Subject 8750; UL Class 2 listed power supply, isolated output, and designed for type and quantity of LEDs served.
1. Input Rating: 120 to 277 V, 60 Hz, plus or minus 10 percent.
2. Output Rating: 12 or 24 V dc, based on lumen output with minimum of 350 mA, plus or minus 5 percent.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Minimum Operating Temperature: minus 40 deg F.
7. Power Factor: 0.90 or higher.

C. Drivers for Dimmer-Controlled Lighting Fixtures: Electronic type.
1. Dimming Range: 100 to 10 percent of rated LED lumens.
2. Driver Input Watts: Can be reduced to 25 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
4. Control: 0 to 10 V dc.

2.4 EMERGENCY TRANSFER DEVICE, GENERATOR TRANSFER DEVICE, and WHOLE CIRCUIT TRANSFER DEVICES.

A. Selected luminaires as shown on the drawings shall have a transfer device installed at the factory, or a whole circuit device installed in the field, to automatically transfer the branch circuit from a normal source to an emergency source. Refer to Division 26 Section "Lighting Control Devices" for additional details.

2.5 INTERNAL OCCUPANCY SENSORS

A. Selected luminaires as shown on the drawings shall have an integral occupancy sensor installed at the factory, to automatically de-energize the luminaire after an adjustable period of time when the space is not occupied. Refer to Division 26 Section "Lighting Control Devices" for additional details.

2.6 EXIT SIGNS

A. Description: Comply with UL 924; Comply with NEMA EM 1; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
a. Battery: Sealed, maintenance-free, nickel-cadmium type.
b. Charger: Fully automatic, solid-state type with sealed transfer relay.
c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

3. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.

2.7 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.
   1. Battery: Sealed, maintenance-free, lead-acid type.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
   7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
   8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.8 SOLID-STATE LIGHTING LUMINAIRES

A. LED Package (Component) Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers: Manufacturers of LED drivers and LED modules shall be tested by the Luminaire Manufacturers and the stated warranty shall be based on the compatibility of the tested components, and substituted manufacturers will not be allowed. Refer to the list of approved LED drivers above.

B. LED Luminaires: Photometric data complying with IES LM-79, Energy Star rated by the U.S. Department of Energy, CRI 80 (minimum), color temperature 4000 K, white light produced by binary complementary wavelength conversion. Color mixing red, green, and blue LEDs is not acceptable.
   1. LED Packages, Arrays, and Modules:
      a. Binned for color consistency per NEMA SSL 3; and B50, L70 rating of at least 50,000 hours when tested according to IES LM-80.
      b. LED packages, arrays or modules shall be field replaceable without having to replace the entire luminaire.

2.9 LUMINAIRE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

F. Chains: 12 gage, zinc-plated steel jack chain or double-loop chain.

G. Air-Craft Cable: 3/32-inch stainless steel cable with adjustable cable holder, adjustable plus or minus 6 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 500 and NECA 502.

B. Protect all luminaires from dust, moisture and debris during construction with plastic or other suitable barriers. Clean all luminaire that are dirty.

C. Luminaires: Set level, plumb, and square with ceilings and walls. Install lamps in each luminaire.

D. Temporary Lighting: If it is necessary, and approved by A/E, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

E. Remote Mounting of Ballasts and Solid-State Lighting Drivers: Distance between the ballast or solid-state lighting driver and fixture shall not exceed that recommended by ballast or solid-state lighting driver manufacturer. Verify, with ballast and solid-state lighting driver manufacturers, maximum distance between ballast or solid-state lighting driver and luminaire.

F. Lay-in Ceiling Luminaires Supports: Use grid as a support element.
   1. Install ceiling support system wire cable or chains, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
   2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
   4. Install at least four independent support jack chains from structure to tabs on lighting fixture. Chain shall have breaking strength of the weight of fixture at a safety factor of 3.

G. Suspended Luminaires Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
   4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

I. Install wire guards to exit signs and emergency lighting units in gymnasia, milt-purpose rooms, shops, and stage areas.

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Selected luminaires as shown on the drawings shall have emergency transfer capability and sensors installed. Refer to Division 26 Section "Lighting Control Devices" for all adjustments and tests required on these luminaires.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
   1. Adjust aimable luminaires in the presence of A/E.

END OF SECTION 26 51 00

DIVISION 28

ELECTRONIC SAFETY AND SECURITY

SECTION 28 31 11 – DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Manual fire-alarm boxes.
2. System smoke detectors.
3. Heat detectors.
4. Notification appliances.
5. Device guards.
6. Magnetic door holders.
7. Remote annunciator.
8. Addressable interface device.
9. Fire alarm wire and cable.

B. The Fire Alarm System is a delegated design and shall be completed by an Ohio Certified Fire Alarm System Designer, minimum NICET Level III.

C. The Fire Alarm System Designer shall prepare construction documents and Fire Alarm Shop Drawings in accordance with Ohio Building Code and NFPA 72, as amended.

D. Fire alarm system equipment, devices, and notification appliances shown on the drawings indicate generalized locations and generalized requirements. Exact types, locations, quantities, settings, etc., shall be determined by the Fire Alarm System Designer and indicated on the Fire Alarm Shop Drawings. Coordinate exact locations with Fire Alarm Shop Drawings prior to rough-in.

E. The Fire Alarm System in the existing portion of the building is to remain as is and be expanded to include additions. This project includes expansion of the existing horn / strobe fire alarm system (all required devices and equipment) into the additions and renovated portions of the building, with limited modifications to the fire alarm system components within the existing portions of the building as affected by the addition/renovation work.

1.2 DEFINITIONS

A. FACP: Fire Alarm Control Panel.

B. LED: Light-emitting diode.

C. NICET: National Institute for Certification in Engineering Technologies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.
1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.
1. Include plans, elevations, sections, details, and attachments to other work. Submit simultaneously with Product Data.
2. Submit to authorities having jurisdiction for approval, submittals reviewed and marked “No Exceptions Taken” by Architect.
3. Shop Drawings shall be prepared by persons with the following qualifications:
a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified fire-alarm technician, Level III minimum.
c. Licensed or certified by authorities having jurisdiction.

4. Comply with recommendations and requirements in the "Documentation" Section of the "Fundamentals" Chapter in NFPA 72.
5. Include voltage drop calculations for notification appliance circuits.
6. Include battery-size calculations.
7. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
8. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors according to manufacturer's written recommendations.
    d. Show air-sampling detector pipe routing.
9. Include floor plans to indicate final outlet locations showing address of each addressable device.
10. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
11. Detail assembly and support requirements.
12. Include input/output matrix.
13. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
14. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
    1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
        a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
        b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
        c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
        d. Riser diagram.
        e. Device addresses.
        f. Record copy of site-specific software.
        g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
            1) Equipment tested.
            2) Frequency of testing of installed components.
            3) Frequency of inspection of installed components.
            4) Requirements and recommendations related to results of maintenance.
            5) Manufacturer's user training manuals.

h. Manufacturer's required maintenance related to system warranty requirements.
i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Smoke Detectors, Heat Detectors, and Carbon Monoxide Detectors: Quantity equal to TEN PERCENT of amount of each type installed, but no fewer than one unit of each type.
2. Detector Bases: Quantity equal to TWO PERCENT of amount of each type installed, but no fewer than one unit of each type.
3. Manual Fire Alarm Box: ONE of each type installed.
4. Keys and Tools: ONE extra set for access to locked or tamper-proofed components.
5. Audible and Visual Notification Appliances: Quantity equal to TWO PERCENT, but no fewer than THREE of each type installed.
6. Addressable interface device: TWO of each type installed.
7. Fuses: TWO of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.7 QUALITY ASSURANCE

A. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

B. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
1. Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
2. Distributors shall also be certified by the manufacturer.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

D. Fire Alarm Wire and Cable Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
1. Notify Construction Manager no fewer than two days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Construction Manager's written permission.

1.9 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.10 WARRANTY

A. Contractor shall warranty all Work performed, all material and equipment furnished in this Project free from defects for a period of two (2) years from the date of substantial completion.

1.11 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
   1. Provide 30 days' notice to Owner to allow scheduling and access to system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Equipment shall be Simplex to be compatible with existing fire alarm system to remain in balance of building.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
   1. Manual stations.
   2. Heat detectors.
   3. Smoke detectors.
   4. Duct smoke detectors.
   5. Carbon monoxide detectors.
   6. Combustible gas detectors.
   7. Automatic sprinkler system water flow.
   8. Preaction system.
   9. Fire-extinguishing system operation.
   10. Fire standpipe system.
   11. Dry system pressure flow switch.
   12. Fire pump running.

B. Fire-alarm signal shall initiate the following actions:
   1. Continuously operate alarm notification appliances, including voice evacuation notices.
   2. Identify alarm and specific initiating device at fire-alarm control units and remote annunciators.
   3. Identify alarm and specific initiating device at connected network control panels and/or off-premises network control panels.

4. Transmit an alarm signal to the remote alarm receiving station.
5. Unlock electric door locks in designated egress paths.
6. Release fire and smoke doors held open by magnetic door holders.
7. Activate voice/alarm communication system.
8. Switch designated heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
9. Close smoke dampers in air ducts of designated air-handling duct systems.
10. Transmit an alarm signal to building management system per air-handling systems zone.
11. Activate kitchen equipment shunt-trip circuit breakers on fire-extinguishing system operation.
12. Activate emergency shutoffs for gas and fuel supplies, including emergency generators where required by local codes.
13. Record events in the system memory.
14. Indicate device in alarm on the graphic annunciator.

C. Supervisory Signal:
1. Supervisory signal initiation shall be by one or more of the following devices and actions:
2. Valve supervisory switch.
3. High- or low-air-pressure switch of a dry-pipe or pre-action sprinkler system.
4. Alert and Action signals of air-sampling detector system.
5. Elevator shunt-trip supervision.
6. Fire pump running.
7. Fire-pump loss of power.
8. Fire-pump power phase reversal.
9. Independent fire-detection and -suppression systems.
10. User disabling of zones or individual devices.
11. Loss of communication with any panel on the network.
12. Generator running
13. Generator abnormal condition (e.g. failure to start, temperature alarms, low fluids, etc.)

D. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.
4. Kitchen equipment shunt-trip supervision.

E. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

F. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.
c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
d. The FACP shall be listed for connection to a central-station signaling system service.
e. The FACP shall be listed for use with supervisory signals from other essential building systems.
f. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 10,000-event history log. The history log shall be able to be exported to a USB drive.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:
1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
a. Initiating Device Circuits: Style A.
b. Notification Appliance Circuits: Style Y.
c. Signaling Line Circuits: Style 4.
d. Install no more than 70 percent rated capacity of addressable devices on each signaling line circuit.
e. Install no more than 70 percent rated capacity of notification appliances on each notification appliance circuit.
2. Serial Interfaces: One USB or RS-232 port for service connection.

D. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

E. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

F. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

G. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
    a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
    b. Programmable tone and message sequence selection.
    c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

H. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
    1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
    1. Backup Batteries: Sealed, valve-regulated, recombinant lead acid.

K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
    1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
    2. Station Reset: Key- or wrench-operated switch.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:
    1. Comply with UL 268; operating at 24-V dc, nominal.
    2. Detectors shall be four-wire type.
    3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
    4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F .
    c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, with screw terminals for system connections, and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
   1. Rated Light Output: 110 cd, unless indicated otherwise.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   4. Flashing shall be in a temporal pattern, synchronized with other units.
   5. Strobe Leads: Factory connected to screw terminals.
   6. Mounting Faceplate: Factory finished, red.

D. Weatherproof Bells: Electric-vibrating, 24-V dc, under-dome type; with provision for housing operating mechanism behind bell. Bells shall produce a sound-pressure level of 94 dBA, measured 10 feet from bell. 10-inch size, unless otherwise indicated.

E. Voice/Alarm Notification Appliances:
   1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
      a. Cone-Type Loudspeakers:
         1) High-Range Units: Rated 2 to 8 W.
            a) Minimum Axial Sensitivity: 93 dB at 10 feet at rated output.
         2) Low-Range Units: Rated 1/4 to 2 W.
            a) Minimum Axial Sensitivity: 84 dB at 10 feet at rated output.
         3) Frequency Response: Within plus or minus 3 dB from 400 to 4,000 Hz.
         4) Minimum Dispersion Angle: 100 degrees, minus 6 dB at 2,000 Hz.
         5) Matching Transformer: Full-power rated with four taps. Maximum insertion loss of 0.5 dB.
         6) Mounting: Flush or semirecessed, wall and ceiling mounted, unless noted otherwise.
            a) Flush-Ceiling-Mounting Units: In steel back boxes. Metal ceiling grille with white baked enamel.
      b. Horn-Type Loudspeakers:
         1) Type: Single- and multiple-horn units, double-reentrant design, with minimum full-range power rating of 15 W.
         2) Minimum Axial Sensitivity: 102 dB at 10 feet at rated output.
         3) Frequency Response: Within plus or minus 3 dB from 400 to 4,000 Hz.
         4) Minimum Dispersion Angle: 70 degrees, minus 6 dB at 2,000 Hz.
         5) Matching Transformer: Full-power rated with four standard taps. Maximum insertion loss of 0.5 dB.
         6) Mounting: Integral bracket.
            a) Multiple-horn Units: Factory installed to prefabricated 10- by 10- by 6-inch nominal steel enclosure suitable for pendent mounting.

2.8 NOTIFICATION APPLIANCE CIRCUIT POWER SUPPLY UNITS

A. General Requirements for Notification Appliance Circuit Power Supply Unit:
   1. Power-limited design, complying with UL 864 and listed and labeled by an NRTL.

B. Notification Appliance Circuits: NFPA 72, Class B, Style Y.
   1. Install no more than 70 percent rated capacity of notification appliances on each notification appliance circuit.

C. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, trouble signals, and supervisory signals shall be powered by 24-V dc source.
   1. Alarm current draw of entire notification appliance circuit power supply unit shall not exceed 80 percent of the power-supply module rating.

D. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
   1. Backup Battery: Premium, valve-regulated, recombinant-sealed, lead-calcium battery; spill proof; with a full 1-year warranty and a pro rata 19-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.
   2. Backup Power Supply Capacity: Comply with NFPA 72, but not less than 24 hours normal and 30 minutes alarm operation.

2.9 MAGNETIC DOOR HOLDERS

A. Products: Subject to compliance with requirements, provide one of the following products:
   1. Dorma-USA: EM508-24120
   2. Edwards Signaling: 1508-AQN5
   3. GE Security: 1508-AQN5
   4. Honeywell Notifier: FM996
   5. LCN Closers: SEM 7830/ SEM 1960
   6. Rixson Specialty Door Controls: 996/ 991
   7. Sargent Lock: 1560
   8. Siemens: SDH-3

B. Description: Units are equipped for wall mounting complete with matching doorplate.
   1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
   2. Wall-Mounted Units: Surface mounted at least 2.375-inches deep, with maximum 1.625-inch deep pin-pivoted door armature. The use of ball-jointed catches and extension links on door armatures is not permitted.
   3. Rating: 120-V ac.

C. Material and Finish: Brushed or painted aluminum.

2.10 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
   1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
   1. Graphic Annunciator:
      a. Backbox: Cold rolled steel with welded and ground seams, finished with black polyester powder coating.

b. Door: Satin finished stainless steel or brushed aluminum, with concealed piano hinge, secured by a key lock with no other visible fasteners.
c. Graphic: Reversed printed polycarbonate lexan laminated to aluminum, with full color image, and LEDs indicating alarm, trouble, or supervisory condition, and fire alarm device type. Building detail shall be selected and color-coded as directed by Owner and Architect/Engineer.
d. Provide keyed lamp test switch.
e. Provide "power-on" LED indicator.
f. Wiring: LED and switch wiring shall be neatly harnessed to designated terminal blocks located in annunciator backbox.
g. Install alphanumeric display in face of graphic.
h. Install graphic annunciator adjacent to alphanumeric display.

2. Graphic Map:
a. Graphic: Provide new graphic map at all existing annunciators and existing and new fire alarm panels and equipment updated to include new construction at completion of project. Full color image printed on the reverse side of a 10 mil polycarbonate Lexan laminated to a 1/8-inch rigid backing with a removable adhesive for future replacement.
b. Frame: Black anodized aluminum frame with concealed security hanging system to prevent unauthorized removal.
c. Location of fire-alarm control unit, main graphic map and other graphic maps shall be shown in red with "YOU ARE HERE" printed in red. Detection devices, nomenclature, and building detail shall be color coded as selected by Owner and Architect/Engineer.
d. Mounting: Adjacent to remote annunciator.

2.11 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to the following:
1. Elevator controller to initiate elevator recall.
2. Circuit-breaker shunt trip for power shutdown.
3. Theatrical lighting controller for panic lighting.
4. Heating, ventilating, and air-conditioning equipment controllers for power shutdown.
5. Smoke dampers for closing.
6. Magnetic door holders, electric locks, coiling doors and grilles for releasing.
7. Building management system for equipment shutdown and alarm notification.
8. Gas and fuel solenoid valves for emergency shut-off.
9. Paging and classroom sound reinforcement equipment audio muting.

C. Voltage Sensing Relay: Capable of detecting presence of 120 V ac for supervision of control power for shunt-trip circuit breakers.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Existing digital alarm communicator transmitter shall be reused.

2.13 SMOKE DAMPERS

A. Smoke dampers, when shown on drawings or in other specifications, shall be provided by others. Provide 120 volt A.C. power circuits, fire alarm interface device, smoke dampers, remote alarm indicator and control wiring as required to operate smoke dampers as required in system operational description above.

2.14 PATHWAYS

A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
   1. Support brackets with cable tie slots for fastening cable ties to brackets.
   2. Lacing bars, spools, J-hooks, and D-rings.
   3. Straps and other devices.
   4. Cable Ties: Comply with Division 26 Section “Identification of Electrical Systems.”

B. Cable Trays: Comply with requirements in Division 26 Section "Cable Trays for Electrical Systems."

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
   1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.15 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
   1. Low-Voltage Circuits: No. 16 AWG, minimum.
   2. Line-Voltage Circuits: No. 12 AWG, minimum.
   3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

2.16 IDENTIFICATION PRODUCTS

A. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

A. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.

3.2 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in a dedicated raceway system according to Division 26 Section "Raceway and Boxes for Electrical Systems," except within consoles, cabinets, desks, and counters or as noted below. This system shall not be used for any other wire or cable. Conceal raceways except in unfinished spaces.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 REMOVAL OF CONDUCTORS AND CABLES

A. For existing building that require demolition, remove abandoned conductors and cables. Refer to Division 26 Section " Electrical Demolition" Specification.

3.4 EQUIPMENT INSTALLATION

A. Comply with NECA 305.

B. Comply with NFPA 72 for installation of fire-alarm equipment.

C. Equipment Mounting: Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
   1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
   1. Connect new equipment to existing control panel in existing part of the building.
   2. Connect new equipment to existing monitoring equipment at the supervising station.
   3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

E. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser on return-air opening.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
   1. Provide for air-handling units with capacity of 2000 cfm or greater.
   2. Provide for variable air volume type fan-powered terminal units served by return air plenums with capacity of 2000 cfm or greater.
   3. Provide within 5 feet of smoke dampers.

G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
   1. Install flush in ceiling below duct smoke detectors, unless otherwise indicated.
   2. Install in public space near device they monitor. Do not install in normally unoccupied spaces.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.

J. Notification Appliance Circuit Power Supply Units: Provide quantity of units required for notification appliances indicated.
   1. Provide system smoke detector at each group of units.
   2. Provide 120 V, 20 A circuit to each unit.

K. Mechanical Equipment Rooms and Kitchens: Provide 190 deg F fixed heat detectors.

L. Device Location-Indicating Lights: Locate in public space near the device they monitor.

M. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

N. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

O. Wire Guards: Install wire guards on fire alarm devices located in gymnasia, multi-purpose rooms, stages, and shop areas.

P. Sprinkler Bell: Install weatherproof bell at fire department connections.

Q. Additional mounting heights are specified in Division 26 Section "Wiring Devices."

3.5 CONNECTIONS

A. For fire-protection systems related to overhead coiling fire doors and coiling counter fire doors in fire-rated walls and partitions and in smoke partitions, comply with requirements in Division 08 Section "Overhead Coiling Fire Doors" and Division 08 Section "Coiling Counter Fire Doors." Connect hardware and devices to fire-alarm system.
   1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Smoke dampers in air ducts of designated air-handling duct systems.
   2. Air-handling unit controllers of designated air-handling systems.
   3. Variable air volume type fan-powered box controllers of designated air-handling systems.
   4. Unlock electric door locks in designated egress paths.
   5. Release magnetic door holders.
   6. Activate circuit breaker shunt-trip to elevator controller.
   7. Activate circuit breaker shunt-trip to designate kitchen equipment.
   8. Alarm-initiating connection to building management system of designated air-handling duct system.
   9. Alarm-initiating connection to elevator recall system and components.
   10. Alarm-initiating connection to activate theatrical lighting control.
   11. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   12. Alarm-initiating connection to overhead coiling fire doors and coiling counter fire doors.
   13. Supervisory connections at valve supervisory switches.
   14. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
   15. Supervisory connections at elevator shunt trip breaker.
   16. Supervisory connections at kitchen equipment shunt trip breakers.

17. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
18. Supervisory connections at fire-pump engine control panel.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.7 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Firestopping."

3.8 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. An equipment grounding conductor shall be installed in the branch circuit from the main service ground to fire-alarm control unit.

3.9 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:
1. Visual Inspection: Conduct visual inspection prior to testing.
   a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
   b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 31 11

DIVISION 31

EARTHWORK

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Protecting existing trees, shrubs, groundcovers, plants, and grass to remain.
2. Removing existing trees, shrubs, groundcovers, plants, and grass.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and abandoning site utilities in place.
7. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:
1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities.
2. Division 01 Section "Execution" for verifying utility locations and for recording field measurements.
3. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
4. Division 23 Section "Turf and Grasses" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; free of subsoil, clay lumps, gravel, and other objects more than 1 inch in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 SYSTEM DESCRIPTION

A. Requirement of Regulatory Agencies: All work shall conform to regulations, codes, safety requirements, ordinances, and laws of federal, state, and local governing bodies having jurisdiction. Keep a copy of the Soil Erosion and Sediment Control Plan on-site at all times during construction.

B. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or air borne dust to adjacent properties and sidewalks according to requirements of authorities having jurisdiction, sediment and erosion control drawings, and/or EPA 832/R-92-005, whichever is more stringent.

1.5 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain as or on Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site and disposal of in an acceptable manner.

B. When the Contractor's excavating operations encounter remains of prehistoric people's dwelling sites or artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. The A/E or Owner will contact archaeological authorities to determine the disposition thereof. After consultation with the archaeological authorities, the Owner may elect to discontinue the work in the area indefinitely, resume normal excavation, or excavate for artifacts.
   1. When directed by the Owner to excavate for artifacts, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and shall remove them for delivery to the custody of the proper authorities. Such excavation will be considered and paid for as extra work.

1.6 SUBMITTALS

A. Quality Assurance/Control Submittals
   1. Product Data: Silt fence data, including capacities.
   2. Contractor shall supply a copy of the log kept of erosion control monitoring and repairs, as well as means and methods for temporary controls.
   3. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
   4. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination". Hold in conjunction with the preinstallation conferences for the following sections:
   1. Division 31 Section "Earth Moving."
   2. Division 33 Section "Common Work Results for Utilities."
   3. Division 33 Section "Utility Services."
   4. Division 33 Section "Subdrainage."

1.8 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Notify corporations, companies, individuals, and local authorities owning conduits, wires, or pipes that will be affected by this Work. Arrange for removal of wires running to or on the property that will interfere with the execution of the Work.
   1. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Protect and maintain conduit, drains, sewers, pipes, and wires that are to remain. Provide and maintain markers for location of underground facilities.

F. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."
   1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

B. Soil Erosion and Sedimentation Control
   1. Straw Bale Filters, Sediment Traps, and Silt Fence.
   2. Rip Rap: Sound and durable rock shall be free of soil and placed as a rock fill for the protection of slopes so denoted on the Drawings. Thin, slablike pieces shall not be used. Rock shall consist of sizes such that the amount of material passing a 3 inch sieve shall not be more than 15 percent by weight of the total material, and the amount of material passing a 6 inch square opening shall not be more than 50 percent by weight of the total material.
   3. Temporary seeding.
      a. Northern States Temporary Seeding Mix; Seeding Rate: 8 lbs/1,000 sq.ft.
         1) 85 percent Perennial Ryegrass
         2) 15 percent Annual Ryegrass
   4. Mulch shall be one of the following:
      a. Straw to be dry, unchopped, free of undesirable seeds.
   5. Erosion control blankets.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to a sediment and erosion control plan, specific to the site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

B. Sequence of Construction Activities
   1. Install silt fence, sediment traps, and straw bale filters as part of initial phase of any work to ensure maximum silt retention.
   2. Mass grade the site keeping disturbed areas to a minimum at all times. Seed and mulch sides of swales, mounds, and ponds immediately upon completion. Application of temporary seeding will be required for all disturbed areas that cannot be final seeded within a time period that will prevent slope erosion. Temporary seeding will be required on all areas to be left disturbed in excess of 30 days. All temporary seeded areas shall be straw mulched in conformance with Division 32 Section “Turf and Grasses”.

3. Control mud accumulation on all streets surrounding project by installing stone surface at each location where construction traffic leaves the site. Keep dust to a minimum by utilizing sprinkling, calcium chloride, vegetative cover, spray on adhesives, or other approved methods.
4. Maintain all filters and traps during construction to prevent any blockages from accumulated sediment. Clean sediment traps, filters, and fencing after each storm event and on a weekly basis. Replace all materials that are clogged or ineffective, 20 percent of capacity lost or obstructed.
5. As storm sewer lines are installed, install a silt barrier at each inlet and on each drainage swale at maximum 50 foot intervals.
6. Remove temporary erosion control and sediment controls only when sufficient growth of ground cover is established to prevent further erosion.
7. Place riprap in areas of high velocity water flow or as noted on the Drawings.

C. Temporary Seeding
1. If swale banks and slopes of five horizontal to one vertical or greater cannot be permanently seeded immediately after grading, temporarily seed these areas using erosion control blankets in conformance with Division 32 Section “Turf Grasses”.
2. Mulch shall be one of the following with a coverage of at least 75 percent of the soil surface:
   a. Install straw or hay mulch at a rate of 1-1/2 to 2 tons/acre, spread by hand or machine. Anchor it immediately, using one of the following methods: Crimp with mulch anchoring tool; a weighted farm disc with dull serrated blades set straight; track cleats of a bulldozer; hydro mulch with short cellulose fibers; or apply liquid tackifier or cover with biodegradable netting secured with staples.
3. Check for erosion damage after each storm event and on a weekly basis. Reseed and mulch as required.
4. If grading occurs during December, January, or February, no seeding is to take place until Spring planting time. All sediment filters and traps are to be in place prior to bulk earth moving and clearing.
5. All areas along streets (approximately 25 feet behind curb or edge of road) shall be seeded with permanent seed mixture as soon as grade is established. Reseeding may be required after utility companies have installed their mains.
   a. Mow monthly, regardless, from March through October.
6. All existing lawns and seeded areas as defined shall be maintained in accordance with Division 32 Section “Turf and Grasses”.
   a. If area remains undisturbed, it must be mowed monthly beginning in March through October.

D. Monitoring: Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
1. Monitor soil erosion control practices at least weekly to determine the effectiveness of the installation and make any repairs required. Keep a detailed log of these observations and remedies taken.
2. Clean out siltation filters when siltation reduces capacity by 20 percent. Material removed may be dried and used as embankment material only in areas approved by the A/E.

E. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
   1. Cover exposed roots with burlap and water regularly.
   2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
   3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
   4. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in accordance with ANSI A300.
   1. Replace trees that cannot be repaired and restored to full-growth status, as determined by Architect.

3.4 UTILITIES

A. Contractor to arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing. Coordinate with the Owner and Construction Manager before disconnecting service
   1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.
   2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

E. Removal of underground utilities is included in Sections covering site utilities.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Cut roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   3. Completely remove stumps of trees, shrubs, and other vegetation including the roots.
   4. Remove stumps roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
   5. Use only hand methods for grubbing within tree protection zone.
   6. Remove tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.
   2. Fill stump holes with structural fill.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths topsoil materials are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
   2. At seeding areas, a minimum of 6 inches of topsoil is required after final grading. Where changes in contours are indicated in these areas, topsoil is not required to be removed to its full depth as indicated finish contours will allow, or have, 6 inches of topsoil after final grading.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and surround with a silt fence.
   1. Limit height of topsoil stockpiles to 72 inches.
   2. Do not stockpile topsoil within tree protection zones.
   3. Dispose of excess topsoil as specified for waste material disposal.
   4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

C. Where catch basins or other underground structures are removed and drainage lines are encountered that cannot be abandoned, provide and install the necessary sewer tile so that maintenance of the lines can be assured. This will particularly apply to subsurface drainage lines, which should be maintained to assure proper drainage. Obtain Architect/Engineer approval for rerouting such lines.
   1. Fill the open ends of abandoned sewers or drains encountered in excavation with concrete or mortared masonry, as per Local and State Codes.

3.8 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
   1. Burning of combustible cleared and grubbed materials is not permitted on Owner’s property.
   2. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 31 10 00

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Subbase course for concrete walks, and pavements.
4. Subsurface drainage backfill for walls and trenches.
5. Excavating and backfilling for utility trenches.
6. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:
1. Division 01 Section "Allowances" for quantity allowance provisions related to unit-price rock excavation and authorized additional excavation.
2. Division 01 Section "Unit Prices" for unit-price rock excavation and authorized additional excavation provisions.
3. Division 01 Section "Construction Progress Documentation" for recording preexcavation and earthwork progress.
4. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
5. Division 01 Section "Milestone Schedule" for compacted fill settlement monitoring.
6. Division 03 Section "Cast-in-Place Concrete" for drainage fill (coarse) and vapor retarder/barrier beneath the slab-on-grade.
7. Divisions 21, 22, 23, 26, 27, and 28 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
8. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
9. Division 32 Section "Turf and Grasses" for topsoil analysis.
10. Division 32 Section "Plants" for planting bed establishment and tree and shrub pit excavation and planting.
11. Division 33 Section "Subdrainage" for drainage of foundations, slabs-on-grade, walls, and landscaped areas.

1.3 UNIT PRICES

A. Unit prices for earthwork are included in Division 01 Section "Unit Prices."

B. Quantity allowances for earthwork are included in Division 01 Section "Allowances."

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.
1. 24 inches outside of concrete forms other than at footings.
2. 12 inches outside of concrete forms at footings.
3. 6 inches outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
5. 6 inches beneath bottom of concrete slabs-on-grade.

6. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
   2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 50 blows/2 inches when tested by an independent geotechnical testing agency, according to ASTM D 1586.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course (Aggregate): Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

L. Topsoil: Organic plant growth material that is cleaned of debris, roots, rocks, soils clumps, weeds and other non-soil contaminants prior placement whether stockpiled or transported on-site.

M. Manufactured Free-Draining Topsoil: Soil produced off-site by homogeneously blending soils and sand with stabilized organic soil amendments to produce topsoil or planting soil for use in rain gardens and bioretention areas..

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at Project site.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
    a. Personnel and equipment needed to make progress and avoid delays.
    b. Coordination of Work with utility locator service.
    c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
    d. Extent of trenching by hand or with air spade.
    e. Field quality control.

1.6 SUBMITTALS

A. Quality Assurance/Control Submittals:
1. Product Data: For the following:
    a. Each type of plastic warning tape.
    b. Geotextile.
    c. Controlled low-strength material, including design mixture.
2. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
    a. Classification according to ASTM D 2487 of each borrow soil material proposed for fill and backfill.
    b. Laboratory compaction curve according to ASTM D 698 for each on-site and borrow soil material proposed for fill and backfill.

1.7 QUALITY ASSURANCE

A. Blasting: Is not permitted:

B. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section “Project Management and Coordination”. Hold in conjunction with the preinstallation conferences for the following sections:
1. Division 31 Section “Site Clearing.”
2. Division 31 Section “Rammed Aggregate Pier Foundation Systems.”
3. Division 33 Section “Common Work Results for Utilities.”
4. Division 33 Section “Utility Services.”
5. Division 33 Section “Subdrainage.”

1.8 PROJECT CONDITIONS

A. Site Information: Data furnished by Owner in Soils Exploration Report (following Information Available To Bidders) of indicated subsurface conditions is not intended as representations or warrants of continuity of such conditions between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn there from by Contractor. Data is made available for the convenience of Contractor.
1. Contractor at no cost to Owner may make additional test borings and other exploratory operations.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Architect immediately for directions as to procedure. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
2. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
3. Do not proceed with utility interruptions without written permission.

4. Contact utility-locator service for area where Project is located before excavating.

C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

D. Fill placement for the building pad will impose added weight to the existing soils. This added weight will cause the existing soils to consolidate. Construction of structures including pavements shall not proceed until it has been verified that the rate of settlement of the native soils has attenuated. Installation and monitoring of settlement points on the surface of the finished subgrade fill will be conducted by the on-site construction testing company hired by the owner. The settlement points shall be monitored routinely to verify the settlement of the new fill caused by the consolidation of the underlying native soils. Once the settlement rates have been verified as having attenuated to no greater than 0.01 feet per week for at least two consecutive weeks, construction of structures including pavements may commence. Surface elevations of the subgrade shall be monitored by placing settlement points at spacing no greater than 100 feet. Monitoring should be done at a frequency no greater than weekly. This elevation data shall be monitored by the testing company to assess the progression of settlements and to make any necessary changes or recommendations. Soil settlement due to fill placement will occur over time and may delay the beginning of foundation excavations. It is estimate that 1.5 inches of settlement may occur and it will take approximately 4 weeks for 90 % of that settlement to attenuate.

E. Contractor is to reference the project milestone schedule.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide product by the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.
1. Soils classified as CL and ML that have less than 50% silt particle size shall be considered as satisfactory soils.
2. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of crushed gravel, crushed stone, and crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Engineered Fill/Granular Fill: "Satisfactory Soils" or naturally or artificially graded mixture of crushed gravel, crushed stone, and crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve, unless otherwise noted.
   1. Aggregates used for subsurface storm water storage, underdrains, or storm sewer backfill shall be washed limestone, washed gravel, or river rock. The aggregates shall be 100 percent crushed in all cases.
   2. "Satisfactory Soil" material shall be compacted in controlled lifts as verified by a representative of the geotechnical engineer by monitoring and testing to have achieved the minimum specified density and stability required based on its location and function.

F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2 sieve and 0 to 5 percent passing a No. 8 sieve.

H. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

I. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.3 TOPSOIL

A. Topsoil (Planting Soil): ASTM D 5268, pH range of 5.5 to 7, a minimum of 6 percent organic material content; screened to be free of stones 1/2 inch or larger in any dimension and other extraneous materials harmful to plant growth.
   1. Topsoil Source (Disturbed Areas): Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean stripped topsoil of roots, plants, sod, stones, clay clumps, and other extraneous material harmful to plant growth.
      a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from bogs or marshes.
   2. Topsoil Source (Undisturbed): Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Provide surface soil free of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
      a. Surface soil may be supplemented with imported or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from bogs or marshes.
   3. Additional Properties of Imported Topsoil or Manufactured Topsoil:
      a. Provide screened surface soil free of stones 1/2 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth.
      b. Free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass; not infested with nematodes, grubs, other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration.
      c. Continuous, air-filled, pore-space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.

2.4 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
   3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
   4. Tear Strength: 56 lbf; ASTM D 4533.
   5. Puncture Strength: 56 lbf; ASTM D 4833.
   6. Apparent Opening Size: No. 60sieve, maximum; ASTM D 4751.
   7. Permittivity: 0.2 per second, minimum; ASTM D 4491.
   8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
   3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
   4. Tear Strength: 90 lbf; ASTM D 4533.
   5. Puncture Strength: 90 lbf; ASTM D 4833.
   6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
   7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
   8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

C. Reinforcing Fabric
   1. Reinforcing fabric shall be made from woven polypropylene containing heavy monofilament and fibrillated yarns with the minimum physical properties:

a.	Grab Strength	ASTM D4632	250 lbs
b.	Mullen Burst	ASTM D3786	750 psi
c.	Trapezoidal Tear	ASTM D4533	110 psi
d.	Water Flow Rate	ASTM D4491	40 gpm

   2. Typically used as subgrade stabilization

D. Reinforcing Geogrid
   1. Reinforcing geogrid shall be made from polypropylene with the minimum physical properties:

a.	True Initial Modulus In Use	Type I	17,140 lb/ft.
b.	Flexural Stiffness	Type I	250,000 cm
c.	Aperture Stability Modulus	Type I	3.2 deg
d.	Resistance to Installation Damage	Type I	70% GP

   2. Typically used as subgrade stabilization

2.5 CONTROLLED LOW-STRENGTH MATERIAL (FLOWABLE FILL)

A. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:
   1. Portland Cement: ASTM C 150, Type I or III.
   2. Fly Ash: ASTM C 618, Class C or F.
   3. Normal-Weight Aggregate: ASTM C 33, 3/4-inch nominal maximum aggregate size.
   4. Water: ASTM C 94/C 94M.
   5. Air-Entraining Admixture: ASTM C 260.

B. Maximum Water Cementitious Ratio: Concrete mixes shall be limited to the water-cement ratios specified in the Concrete Schedule in these Specifications (DIV. 3 - CS-1). Water reducers and fly ash may be used to increase the slump while maintaining or reducing the water-cementitious ratio at or below the maximums specified values, except where specifically prohibited in these specifications.

C. Mix designs for flowable fill shall generally conform to the following guideline mixes:

Material	Type 1 (for utility trench backfill) (lbs/cu yd)	Type 2 (for backfill under structures) (lbs/cu yd)
Cement	50	50-100
Fly Ash	250	
Fine Aggregate	2910	2420
Water	500	210-300
Entrained Air	0%	5 % +/- 1 ½ %

1. Alternate mix designs may be submitted in lieu of the above. Mix designs shall have an unconfined compressive strength when tested according to ASTM D4832 as shown in the Concrete Schedule. Long term (12 months) unconfined compressive strength for utility trench backfill shall be less than 100 psi. Mixes shall be flowable. Mixes shall conform to the requirements of ACI 229 for "Controlled Low Strength Material".
2. Mixes shall set up in less than 12 hours. Flowable fill shall be ready-mixed material.

2.6 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the areas and conditions under which excavating, filling, and grading are to be performed and notify the A/E in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

B. Proof Rolling: After topsoil has been stripped per Division 31 Section "Site Clearing" and excavation made to required subgrade elevations, proof roll areas to be occupied by the new buildings and paved surface areas using a medium weight roller. A representative from the Soil Testing and Inspection Laboratory shall be present during all proof rolling operations.
1. Excavation of unsuitable proof roll bearing materials
    a. Lawn Areas
        1) Unsuitable bearing materials in lawn areas shall not be excavated without written authorization from the architect.
        2) Unsuitable bearing materials excavated in lawn areas shall be considered unauthorized excavation and shall be replaced with suitable bearing materials with no additional payment.
    b. Paved Areas
        1) Unsuitable bearing materials in areas to receive a bituminous or aggregate pavement structure shall not be undercut without written authorization from the A/E.
        2) Unsuitable bearing materials excavated in paved areas without written approval from the A/E shall be considered unauthorized excavation. No contract adjustments will be made for unauthorized excavation.
        3) Prior to excavation of unsuitable materials, the contractor shall report to the soils engineer, Construction Manager, and A/E the quantity of unsuitable soil to be excavated. The contractor shall report the following information:
            a) Quantity in cubic yards

b) Quantity square yards
c) The average depth of cut.

2. Using the quantity information, the architect will consult with the soils engineer regarding alternative methods to remedy the unsuitable soil. Alternatives include:
   a. Installation of an approved reinforcing fabric or reinforcing geogrid
   b. Mechanical stabilization using hydrated lime, calciment or kiln dust, whichever is appropriate based on soil type and intent to “modify” or “stabilize” the soil mass.
   c. Removal and replacement of the unsuitable material
      1) The depth of additional excavation shall be based on the depth of deflection measured during the proofroll operation:
         a) 0 to 1/2 inch – no additional excavation
         b) >1/2 inch to 1 inch – 12” of additional excavation
         c) >1 inch to 1.5 inch – 18” of additional excavation
         d) >1.5 to 2.5 inch – 24” of additional excavation plus an approved reinforcement geosynthetic, if applicable.
      2) Replacement material shall consist of crushed concrete, 100 percent crushed gravel or 100 percent crushed limestone or other satisfactory soil material at the discretion of the A/E and soils engineer.
         a) The size of replacement aggregate material, if utilized, shall be based on the security of the instability.
   d. Disc and Dry
      1) No additional payment will be made to disc and dry.
   e. Other remedy as suggested by the soils engineer or contractor.
3. The A/E will recommend to the owner implementing an alternative or combination of alternatives based upon cost, effectiveness, scheduling impact and recommendations from the soils engineer. The owner shall issue final approval of the remedy.
4. Contract adjustments, if any, shall be in accordance contract provisions.
5. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by A/E, without additional compensation.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.

D. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

E. Provide erosion control measures in accordance with erosion control plan to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.4 EXPLOSIVES

A. Explosives: Do not use explosives.

3.5 EXCAVATION, GENERAL

A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract time may be authorized for rock excavation.
   1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
      a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
   2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
      a. 24 inches outside of concrete forms other than at footings.
      b. 12 inches outside of concrete forms at footings.
      c. 6 inches outside of minimum required dimensions of concrete cast against grade.
      d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
      e. 6 inches beneath bottom of concrete slabs on grade.
      f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

B. Additional Excavation: When excavation has reached required subgrade elevations, notify Soils Engineer and A/E so he can observe conditions.
   1. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by the Representative of Soils Testing and Inspection Laboratory after approval by A/E.
   2. Removal of unsuitable material and its replacement, as directed, will be paid on the basis of contract conditions relative to changes in work.
   3. The assumed quantity of additional excavation for bidding is zero cubic yards, unless otherwise noted. As such, all future estimated quantities of additional excavation should be considered a substantial change in quantity.
   4. All additional excavation or rock excavation performed without written authorization by the A/E shall be considered unauthorized excavation for which no additional payment will be made.
   5. Additional excavation and its replacement will be paid for based on contract provisions for changes in the work or unit prices where applicable.

C. Stability of Excavations: Slope sides of excavations to comply with codes and ordinances having jurisdiction. Shore and brace where sloping is not possible either because of space restriction or stability of material excavated.
   1. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
   2. Comply with OSHA, "Construction Standards for Excavations, 29 CFR".

D. Shoring and Bracing: Provide materials for shoring and bracing such as sheet piling, uprights, stringers, and cross-braces in good serviceable condition.
   1. Provide minimum requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.
   2. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

E. Dewatering: Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations. Remove water to prevent softening of pavement subgrade, foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, sumps, suction, and discharge lines, and other dewatering system components necessary to convey water away from excavations.
2. Convey water removed from excavations and rainwater to collecting or runoff areas. Provide and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.

3.6 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.7 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.8 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
1. Clearance: 12 inches each side of pipe or conduit, unless otherwise noted.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
1. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.
2. Where rock is encountered, carry excavation 6 inches below required elevation and backfill with a 6-inch layer of crushed stone or gravel prior to installation of pipe.
3. For pipes or conduit 5 inches or less in nominal size and for flat-bottomed multiple-duct conduit units, do not excavate beyond indicated depths. Hand excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.
4. For pipes or conduit 6 inches or larger in nominal size, tanks and other mechanical/electrical work indicated to receive subbase, excavate to subbase depth indicated, or, if not otherwise indicated, to 6 inches below bottom of work to be supported.
5. Except as otherwise indicated, excavate for exterior water bearing piping (water, steam, condensate, drainage) so top of piping is not less than 5 feet below finished grade.
6. Grade bottoms of trenches, notching under pipe bells to provide solid bearing for entire body of pipe.

7. Where welded and wrapped black iron pipe, wrought iron pipe, or soft type "K" copper tubing with silver soldered joints is specified, a narrow trench made with special trenching machines will be acceptable, providing it can maintain a straight, true-to-line trench bottom in undisturbed earth to prevent damage to the pipe.
8. Excavation for manholes and other accessories to have 12 inches minimum and 24 inches maximum clearances on all sides.
9. Trenches interior to the building shall be excavated of sufficient width to allow ample working space and performed so walls and footings are not disturbed, weakened, or injured.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, or controlled low-strength material may be used when approved by A/E.
   1. Fill unauthorized excavations under other construction or utility pipe as directed by A/E.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
   2. Dispose of excess soil material and waste materials as specified hereinafter.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for Record Documents.
   3. Testing and inspecting underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring and bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings, piers, or foundations with satisfactory soil; fill with concrete or controlled low-strength material to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete and/or Miscellaneous Cast-in-Place Concrete."
   1. Wrap pipe with one inch glass fiber blanket by pipe installer prior to placement of concrete.

D. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways or paving. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
   1. Backfill when piping or conduit is greater than 30 inches below surface of roadways and paving may be either controlled low-strength material or granular fill.

E. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit, unless otherwise noted.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
   2. Backfill within the building and for piping or conduit below sidewalk shall be granular fill.

F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit.

G. Trench Backfilling for PVC or PE Storm Piping Outside the Building: Backfill storm piping in four phases. Bedding, haunching, initial and finish backfill. Place each lift to equal depths on both sides of pipe. Each lift shall extend from the side of the pipe to the trench wall.

H. Trench Backfilling for Underdrains: Line the trench for underdrains with a nonwoven filter fabric. Completely encase the washed river rock.
   1. Backfill material shall be 3/4 inches diameter washed river rock. Continue the rock from the top of the pipe to the base of the surface material.

I. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

J. Place and compact final backfill of satisfactory soil to final subgrade elevation. Properly compact and stabilize fill before permitting weight or traffic on the backfill.

K. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

A. Disc, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material to where topsoil begins.
   2. Under walks and stoops, use satisfactory soil material to 4 inches below concrete then use subbase material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill to establish subgrade.
      a. Refer to Division 03 Section “Cast-in-Place Concrete” for drainage fill.
   5. Under footings and foundations, lean concrete or controlled low-strength material, unless otherwise approved by A/E and geotechnical engineer.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 TOPSOIL PLACEMENT

A. Limit topsoil placement to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrqade to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
   1. Spread topsoil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if topsoil or subgrade is frozen, muddy, or excessively wet.
      a. Spread approximately 1/2 the thickness of topsoil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil mix.
      b. Reduce elevation of topsoil to allow for soil thickness of sod.

C. Unchanged Subgrades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
    a. Apply fertilizer and soil amendments directly to surface soil before loosening per results of topsoil analysis.
3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

E. Before placing topsoil, restore areas if eroded or otherwise disturbed after finish grading.

3.15 FLOWABLE FILL PLACEMENT

A. Flowable Fill Placement: Discharge the flowable fill material from the ready-mix truck by any reasonable means into the space of the plan intended usage. Bring material up uniformly to the fill line shown on the plans.

B. The Contractor may begin placing other fill materials, as required, over flowable fill as soon as the surface water on the flowable fill is gone.

C. Reinforcing steel for foundations to be placed over flowable fill may be placed 24 hours after placement of flowable fill.

3.16 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content as indicated in geotechnical report.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.17 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the values in the soils report and the following percentages of maximum dry unit weight according to ASTM D 698 (Standard):
1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at least 100 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at least 100 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.

4. For utility trenches, compact each layer of initial and final backfill soil material at least 100 percent within areas under buildings, structures, walks and pavements and to 92 percent minimum within lawn or other areas.

3.18 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish grades to required elevations within the following tolerances:
1. Lawn or Unpaved Areas: Plus or minus 1/2 inch.
2. Walks: Plus or minus 1/2 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.19 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.
2. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

3.20 SUBBASE AND BASE COURSES

A. Place subbase course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course under pavements and walks as follows:
1. Install separation geotextile, where specified, on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase course to required crown elevations and cross-slope grades.
4. Place subbase course 6 inches or less in compacted thickness in a single layer.
5. Place subbase course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 100 percent of maximum dry unit weight according to ASTM D 698.

3.21 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

TABLE 1704.7
REQUIRED VERIFICATION AND INSPECTIONI OF SOILS

Verification and Inspection Task	Continuous During Task Listed	Periodically During Task Listed
1. Verify materials below footings are adequate to achieve the design bearing capacity.	--	X
2. Verify excavations are extended to proper depth and have reached proper material.	--	X
3. Perform classification and testing of controlled fill materials.	--	X
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of controlled fill.	X	--
5. Prior to placement of controlled fill, observe subgrade and verify that site has been prepared properly.	--	X

1. Determine footings have been excavated to proper depths by observing surveying of at least one location for each foundation depth indicated.
2. Determine prior to placement of fill that site has been prepared in compliance with requirements by observing proof rolling operations.
3. Determine that fill material and maximum lift thickness comply with requirements.

B. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by A/E, except that a minimum of one test shall be performed for each 15,000 sq.ft. of building area.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, ASTM 6938 and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

B. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
   1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 20 00

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Hot-mix asphalt patching.
   2. Hot-mix asphalt paving.
   3. Pavement-marking paint.

B. Related Sections:
   1. Division 31 Section “Site Clearing” for removal of above ground improvements.
   2. Division 31 Section "Earth Moving" for aggregate subbase courses and for aggregate pavement shoulders.
   3. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.

1.3 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. DOT: Department of Transportation.

1.4 SYSTEM DESCRIPTION

A. Provide hot mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specification of the Ohio Department of Transportation.

B. Bituminous concrete utilized for this project will conform to Ohio DOT Item 441. Base and binder course material shall meet job formula outlined in section 441.02-1, Type 2. Surface course shall fall within Type 1 limits. All pavements to be designed for medium traffic. The asphalt binder used shall be PG 64-22.

C. Special Conditions
   1. Protection of work in place
      a. All paving work shall be protected from construction traffic at all times after completion. All damaged work shall be replaced with no additional payment.

1.5 SUBMITTALS

A. Quality Assurance/Control Submittals:
   1. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
   2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
      a. Certification: Provide material certificates signed by the material producer and the Contractor, certifying that playground surface mixture does not contain ferrous material or ferrous minerals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the State Department of Transportation Standard Specifications for asphalt paving work, except where modified, changed or added to in this specification:
   1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

C. Preinstallation Conference: Conduct conference at Project site. A/E will schedule and conduct meeting.
   1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
      a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
      b. Review condition of subgrade and preparatory work.
      c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
      d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Tack Coat: Minimum surface temperature of 60 deg F.
   2. Slurry Coat: Comply with weather limitations in ASTM D 3910.
   3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
   4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials and 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide product by the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. The “Substitution Request Form” and complete technical data for evaluation must accompany requests for A/E’s approval. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 COMPACTED AGGREGATE BASE MATERIAL

A. General: Use materials and gradations that have performed satisfactory in previous installations.
   1. Aggregates shall meet ODOT requirements and as indicated.

B. Compacted aggregate base for all pavement types shall consist of natural aggregate. The aggregate shall contain 95 to 100 percent crushed content.
   1. Provide crushed limestone. The contractor may provide 95 to 100 percent crushed gravel. Class B or higher aggregates shall be used in all cases.
   2. Compacted aggregate base material shall conform to the gradation shown in the table for each class of paving.
   3. All compacted aggregate for bituminous paving shall be constructed in two lifts. In no case shall compacted aggregate lifts be thicker than 4 inches.
   4. Compacted aggregate shall contain 0% soft particles, 0 percent shale and 0 percent flat elongated particles.

2.3 MATERIAL GRADATIONS (Percent Passing is shown):

SIEVE SIZE mm (US Sieve)	PARKING AND DRIVES SURFACE COURSE	PLAYGROUND SURFACE	BINDER COURSE	BASE COURSE	COMPACTED AGGREGATE
37.5 (1 ½)				100	100
25.0 (1)			100	80-99	80-100
19.0 (3/4)			80-98	67-90	70-90
12.5 (1/2)	100	100	56-80	42-74	55-80
9.5 (3/8)	85-98	96-100	43-68	33-60	45-70
4.75 (No. 4)	57-67	70-80	30-40	25-35	35-60
2.36 (No. 8)	31-62	36-66	14-40	12-34	25-50
1.18 (No. 16)	17-50	19-50	8-32	7-28	---
600mm (No. 30)	8-37	10-38	5-24	4-22	12-30
300mm (No. 50)	3-25	5-26	2-16	1-16	---
150mm (No. 100)	0-14	2-17	0-10	0-10	---
75mm (No. 200)	0-3	0-4	0-3	0-3	5-10
% Bitumen	5.5-7.0	5.7-7.2	4.1-5.2	4.0-5.1	N/A

2.4 PAVING MATERIALS

A. General: Use locally available materials and gradations, which exhibit a satisfactory record of previous installations.

B. Mineral Filler: Limestone dust, portland cement, or other inert material complying with State Department of Transportation Standard Specifications.

C. Asphalt Cement: Use Performance Grade liquid asphalt's in accordance with State Department of Transportation Standard Specifications.

D. Tack Coat: ASTM D977, emulsified asphalt or ASTM D2397, cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

E. Protective Membrane System: Nonwoven polypropylene fabric and asphalt cement complying with AASHTO M-288-00. Subject to compliance with requirements, provide one of the following products:
   1. Petromat No. 4598; Amoco Fabrics and Fibers Company.

2. Mirafi FG; TC Mirafi.
3. 461 Pavedry; SI Geosolutions.

2.5 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.

C. Painted Pavement-Marking:
1. Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N or Type F; colors complying with FS TT-P-1952. Quality Assurance requirement for pavement markings within public rights-of-ways to be in accordance with US Manual on Uniform Traffic Control Devices.
2. Color: White and Yellow.
3. Accessibility Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.
4. Color: Blue.

D. Hot Tape or Poured in Place Thermoplastic Pavement Markings:
1. Refer to Ohio Department of Transportation Section 640 for materials and installation requirements.

2.6 MIXES

A. All mix design parameters shall be measured in accordance and comply with State Department of Transportation Standard Specifications

1.	VMA%	15
2.	Air Voids %	3.5
3.	Fines/Binder Ratio	1.2
4.	Fine Aggregate Angularity	3
5.	Flow (mm)	2.0 – 4.0
6.	L.A. Abrasion Loss	40
7.	Soft Particle Max.	8
8.	Stability Min.	4.0 kN

2.7 RECYCLED ASPHALT PAVEMENT

A. Recycled asphalt pavement may be used in bituminous base or bituminous binder, and (surface courses), provided the recycled asphalt does not contain objectionable material or materials that are not compatible with paints, coatings or other pavement markings, and do not exceed DOT recommended percentages.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

D. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.4 INSTALLATION OF COMPACTED AGGREGATE BASE

A. The entire area to receive compacted aggregate shall be proof rolled with a tandem dump truck loaded with approximately 15 tons. The proof rolling shall be executed prior to installing the compacted aggregate. All soft and yielding areas shall be repaired.
1. The acceptable observed subgrade deflection shall be 1/2 inch or less measured at the rear tire.

B. Compacted aggregate shall be installed immediately after acceptance of the subgrade proof roll operation by the soils engineer and Architect.
1. The subgrade shall be repaired and the proof roll operation repeated in the event the approved subgrade is disturbed by construction traffic, rain or other circumstance prior to placing the compacted aggregate.
2. The proof roll operation shall be repeated in the event the subgrade is left exposed for 3 work days or more prior to placing the compacted aggregate.

C. Place the aggregate material in accordance with applicable sections of the State Department of Transportation Standard Specifications and as hereinafter specified.

D. Aggregate material shall be compacted to thickness indicated on the Drawings. Each lift shall be compacted with approved rollers to no less than 100 percent of the maximum dry density as determined by Method C of AASHTO T99, as modified in Article 2.03.24.

E. All compacted aggregates for all bituminous pavements shall be installed in 2 lifts.

F. Grade Control: During construction maintain lines and grades, including crown and cross-slope of compacted aggregate course.

G. Shoulders: Where curbs are not indicated, place shoulders along edges of aggregate subbase course to prevent lateral movement. Construct shoulders of acceptable aggregate materials, placed in such quantity to compact to thickness of each aggregate base course layer. Compact and roll at least a 12 inch width of shoulder simultaneously with compacting and rolling of each layer of aggregate subbase course.

3.5 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread HMA base mix at minimum temperature of 250 deg F and HMA Surface Mix at a minimum temperature of 280 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

D. Special Conditions
1. Fenced areas: All fence fabric shall be removed from poles prior to paving fenced areas.
2. The paving machine shall not be allowed to track over or back track over any finished course of freshly placed bituminous mixture while the mixture is still hot or warm. Tracking the paving machine over freshly placed bituminous courses shall render that section of pavement unacceptable. All unacceptable pavements shall be removed and replaced with no additional payment.

3.7 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
   3. Offset transverse joints, in successive courses, a minimum of 24 inches.
   4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
   5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
   6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
   1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 94 percent nor greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   1. Base Course: Plus or minus 1/2 inch.
   2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
   1. Base Course: 1/4 inch.

2. Surface Course: 3/16 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
1. Compacted thickness shall not be less than indicated.

C. Surface Smoothness: Test finished surface of each asphalt concrete course for smoothness, using a 10-foot straightedge applied parallel with, and at right angles to, centerline of paved area. Surfaces will not be accepted if exceeding the following tolerances for smoothness:
1. Binder Course: 1/4 inch.
2. Surface Course: 3/16 inch.
3. Check surface areas at intervals as directed by the Architect.

D. Flood Test
1. Schedule: After the pavement is complete, perform a flood test in the presence of the Architect.
2. Method: Perform the flooding by use of water tank truck or available water.
3. If depressions exist where water is ponding to a depth of more than 1/8 inch, fill with fresh hot asphalt concrete to provide proper drainage. Feather and smooth the edges of fill so that the joint to original surface is not visible.

E. Test uncompacted asphalt concrete mix and report the following:
1. Sampling: AASHTO T168 (ASTM D979).
2. Asphalt Cement Content: AASHTO T164 (ASTM D2172).
3. Perform at least one initial test for paving, unless otherwise specified or directed.

F. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.
1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
   a. One core sample will be taken for every 500 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
   b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

G. Replace and compact hot-mix asphalt where core tests were taken.

H. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.12 FINAL ACCEPTANCE CRITERIA FOR HEAVY AND STANDARD DUTY PAVING

A. Final acceptance for heavy duty and standard duty paving shall be based on asphalt coring within the test area limits as shown on the Drawings. Arrange for and execute core sampling by an independent testing agency. The cost of this testing shall be included in the bid by Contractor.

B. Core Requirements
1. Cores shall be a minimum of 2 inches in diameter and 24 inches in depth.
2. Cores shall be taken at a rate of 1 core every 3000 sq.yds. for each pavement type in each test area. In any case, no less than 4 cores shall be taken in each test area for each type of pavement.
3. The location of the cores shall be at painted lines and as determined by the Engineer and marked on the Drawings after the surface course has been constructed.
4. The total thickness of the surface plus the binder course for each core shall be determined. The total thickness of the compacted aggregate base for each core shall be measured and recorded.
5. The average thickness of each aggregate course for each pavement type shall be determined and recorded for each test area. The average thickness of the surface course plus the binder course shall be determined and recorded for each test area.
6. Voids created as a result of the coring shall be filled using concrete, mortar or other bituminous material as directed.

C. Acceptance Criteria
1. The thickness of each asphalt course as shown on the Drawings is the compacted minimum not an average. If the average thickness of any asphalt or aggregate course is less than that shown on the Drawings, then the entire test area shall be resurfaced using a bituminous surface mixture with appropriate aggregate size to obtain 90 pound per square yard yield without breaking or scratching the aggregate.
2. If the average thickness of the surface plus the binder or the average thickness of the compacted aggregate equals or exceeds the required thickness and if any course in any individual core is less than that shown on the Drawings then, at the discretion of the Engineer, that portion of the test area shall be resurfaced using 90 pound per square yard bituminous surface. Areas requiring resurfacing due to inadequate core samples shall not be less than 2400 square feet.
3. No asphalt materials shall be removed to correct insufficient compacted aggregate once the binder or surface has been placed. The only acceptable corrective measure for insufficient compacted aggregate is additional bituminous material. Substantially insufficient compacted aggregate shall be corrected by additional resurface work constructed at a rate of 1 compacted inch of asphalt for every 2 inches of insufficient aggregate.
4. No additional payment will be made for additional construction necessary due to insufficient cores.

D. Acceptance Submittals
1. No bituminous pavements will be accepted until it has been demonstrated by the Contractor that the pavements are in accordance with the Drawings and Specifications. The Contractor shall submit the following:
    a. Pavement coring report with a drawing illustrating the location of each core taken, asphalt and aggregate thicknesses and subgrade moisture content.
    b. Modified proctor maximum dry density soil data for each soil type used as subgrade within the pavement. The soils data sheet(s) shall indicate which asphalt core or cores the soil corresponds to.
    c. Job mix formula for each type of bituminous mixture. The job mix formula shall contain, at minimum, the aggregate gradation, percent bitumen, source and type of bitumen and the laboratory maximum compacted density for the mixture.
    d. In-place asphalt compaction density test results illustrating the corresponding core to which the test applies.

E. Variation from Job Mix Formula or Required Gradations:
   1. Compliance Criteria
      a. Paving work shall be considered in compliance if the gradations and % bitumen noted in the table are within the specified ranges. No contract adjustments shall be made for all work that is in compliance with these specifications.
   2. Substantial Compliance Criteria
      a. Paving work shall be considered within substantial compliance if the gradations and percent bitumen noted in the table are within plus or minus 0.20
      b. A deduct contract adjustment shall be made at the rate of $0.50 per square yard for each square yard of paving that varies from the Job Mix Formula or the Required Gradations.
   3. Non-Compliance: Paving work shall be considered non-compliant if the gradations and percent bitumen deviate greater than 0.20 of the values in the table.

3.13 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow milled materials to accumulate on-site.

END OF SECTION 32 12 16

SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Isolation and contraction joints within cement concrete pavement.
   2. Joints between cement concrete and asphalt pavement.

1.3 SUBMITTALS

A. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

B. Quality Assurance/Control Submittals:
   1. Product Data: For each joint-sealant product indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
   2. When joint substrates are wet or covered with frost.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the Substitution Request Form” and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 COLD-APPLIED JOINT SEALANTS

A. Multicomponent Sealant for Concrete: Pourable, chemically curing elastomeric formulation complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated, provide one of the following:
   1. Urethane Formulation: Type M; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.
      a. Products:
         1) Pecora Corporation; Urexpan NR-200.
         2) Sonneborn Building Products, Inc., Sonolastic SL2.
         3) Tremco Inc., Vullcem 245.
         4) Sika Corp., Sikaflex 2C SL.

B. Single-Component Urethane Sealant for Concrete: Single-component, pourable, coal-tar-modified, urethane formulation complying with ASTM C 920 for Type S; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.
   1. Products:
      a. Sonneborn, Div. of ChemRex, Inc.; Sonolastic SL-1.
      b. Pecora Corp.; NR-201 Urexpan.
      c. Tremco Inc.; Vulkem 45.
      d. Sika Corp.; Sikaflex ICSL.

C. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
   1. Products:
      a. Crafco Inc.; RoadSaver Silicone.
      b. Dow Corning Corporation; 888.
      c. Sikasil-728 NS

D. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.
   1. Products:
      a. Crafco Inc.; RoadSaver Silicone SL.
      b. Dow Corning Corporation; 890-SL.
      c. Sikasil-728 SL

2.4 HOT-APPLIED JOINT SEALANTS

A. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.
   1. Products:
      a. Koch Materials Company; Product No. 9005.
      b. Koch Materials Company; Product No. 9030.
      c. Meadows, W. R., Inc.; Sealtight Hi-Spec.

2.5 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.6 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of backer materials.
   2. Do not stretch, twist, puncture, or tear backer materials.
   3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses provided for each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealants from surfaces adjacent to joint.
   2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 32 13 73

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Chain-Link Fences: Industrial.
2. Gates: Swing.
3. Pipe Gates
4. Privacy Slats
5. Collapsible Steel Bollards
6. Gate Exit Hardware

B. Related Sections include the following:
1. Division 01 Section "Alternates" for description of Work in this Section affected by alternates.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section “Quality Requirements,” to design chain-link fence and gate frameworks.

B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and water explosive conditions indicated according to ASCE/SEI 7.

C. Design Wind Load: 25 psi, unless otherwise noted.

D. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.All materials and installation to comply with Chain Link Fence Manufacturers Institute (CLFMI.)

E. Structural Performance: Provide chain-link fences and gates capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Minimum Post Size and Maximum Spacing for Wind Velocity Pressure: Determine based on mesh size and pattern specified, and on the following minimum design wind pressures and according to CLFMI WLG 2445:
   a. Wind Speed: 90 mph.
   b. Wind Exposure Category: B.
2. Determine minimum post size, group, and section according to ASTM F 1043 for framework up to 12 feet high, and post spacing not to exceed 10 feet.

F. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

1.4 SUBMITTALS

A. Shop Drawings: Show locations of fences, gates, posts, rails, tension wires, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

B. Samples for Initial Selection: Manufacturer's color charts or 6-inch lengths of actual units showing the full range of colors available for components with factory-applied color finishes.

C. Quality Assurance/Control Submittals:
   1. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.
      a. Fence and gate posts, rails, and fittings.
      b. Chain-link fabric, reinforcements, and attachments.
      c. Gates and hardware.
      d. Plastic Deer Fence
   2. Product Certificates: For each type of chain-link fence and gate, signed by product manufacturer.
      a. Strength test results for framing according to ASTM F 1043.
   3. Qualification Data: For Installer.

D. Closeout Submittals:
   1. Maintenance Data: For the following to include in maintenance manuals:
      a. Gate hardware.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Waste Management and Disposal: As specified in Division 01 Section "Construction Waste Management and Disposal" and as follows:
   1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.
   2. Separate corrugated cardboard in accordance with Waste Management Plan and place in designated areas for recycling.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 Articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for Architect's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 CHAIN-LINK FENCE FABRIC

A. General: Height indicated on Drawings. Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:
   1. Steel Wire Fabric and Mesh Size: 2 inch mesh, metallic-coated wire with a diameter of 0.148 inch.
      a. Provide 1-3/4 inch mesh, 0.120 inch diameter at tennis courts.
      b. Provide 2 inch, 0.192 inch diameter at lower 10 feet of softball backstops and lower 6 feet of baseball backstops.
      c. Weight of Aluminum Coating: ASTM A 491, Type I, 0.4 oz./sq. ft.
      d. Polymer Coating: ASTM D 668, Class 2b over metallic-coated steel wire.
         1) Color: As selected by A/E from manufacturer's full range, complying with ASTM F 934.
      e. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.
   2. Selvage: Knuckled at both selvages, unless otherwise noted.
      a. Twisted top and knuckled bottom, at mechanical yard enclosures.

2.3 INDUSTRIAL FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe and the following:
   1. Group: Provide either IA, round steel pipe, Schedule 40 or IC, round steel pipe, yield strength 50,000 psi.
   2. Fence Height: As indicated.
   3. Post Size and Thickness: According to ASTM F 1043.
      a. Intermediate Posts
         1) Fabric 10 feet and under:
            a) IA: 2.375 inch o.d. with .154-inch wall thickness, 3.65 lbs. per foot.
            b) IC: 2.375 inch o.d. with .130-inch wall thickness, 3.12 lbs. per foot.
         2) Fabric over 10 feet high:
            a) IA: 2.875 inch o.d. with .203-inch wall thickness, 5.79 lbs. per foot.
            b) IC: 2.875 inch o.d. with .160-inch wall thickness, 4.64 lbs. per foot.
      b. End, Corner, and Pull Posts
         1) General
            a) End post will be used to refer to terminal posts.
            b) Corner post will be installed where all changes in direction occur in the fence line of 30 degrees or more.
            c) Pull post shall be installed at all abrupt changes in grade or at locations directed by the Architect with a maximum spacing between pull posts not to exceed 500 feet.
         2) Fabric 10 feet and under
            a) IA: 2.875 inch o.d., with .203-inch wall thickness, 5.79 lbs. per foot.
            b) IC: 2.875 inch o.d., with .160-inch wall thickness, 4.64 lbs. per foot.
         3) Fabric over 10 feet high
            a) IA: 4.0 inch o.d. with .226-inch wall thickness, 9.12 lbs. per foot.
            b) IC: 4.0 inch o.d. with .160-inch wall thickness, 6.56 lbs. per foot.
         4) Tennis Court Fencing
            a) IA: 5.0 inch o.d. with .226-inch wall thickness, 9.12 lbs. per foot.
            b) IC: 5.0 inch o.d. with .160-inch wall thickness, 6.56 lbs. per foot.
   4. Coating for Steel Framing:

a. Metallic Coating, unless otherwise noted.
1) IA: Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq.ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
2) IC: Type C, Zn-5-A1-MM alloy, consisting of not less than 1.8 oz./sq.ft. coating.

5. Posts shall have sufficient length to meet the following embedment requirements:
a. Intermediate Posts: 36 inches (into concrete).
b. End, Corner, and Pull Posts:
1) Fabric 10 feet and under: 36 inches.
2) Fabric over 10 feet: 44 inches.
c. Gate Posts: 48 inches.

B. Post Brace Rails: Match top rail for coating and strength and stiffness requirements. Provide brace rail with truss rod assembly for each gate, end, and pull post. Provide two brace rails extending in opposing directions, each with truss rod assembly, for each corner post and for pull posts. Provide rail ends and clamps for attaching rails to posts.
1. Provide for fences with fabric 6 feet or more in height.

C. Top Rails: Fabricate top rail from lengths 21 feet or longer, with swedged-end or fabricated for expansion-type coupling, forming a continuous rail along top of chain-link fabric.
1. The top rail shall be 1.660 inches o.d. pipe, provided in lengths not less than 18 feet unless otherwise noted, and fitted with couplings for connecting the lengths into a continuous run.
a. IA: .140-inch wall thickness, 2.27 lbs. per lineal foot.
b. IC: .111-inch wall thickness, 1.836 lbs. per lineal foot.
2. Couplings: Top rail couplings shall be a minimum of 6 inches long and at 21 feet maximum intervals, providing a substantial connection and allowing for expansion and connection of the rail.
3. The top rail shall pass through the line post tops and form a continuous brace from end to end of each stretch of fence.
4. The top rail shall securely fasten to the terminal posts by heavy pressed steel brace bands and malleable rail end connections.

D. Intermediate Rails: Match top rail for coating and strength and stiffness requirements.
1. Provide for fences with fabric 8 feet and over, unless otherwise noted.

E. Bottom Rails: Match top rail for coating and strength and stiffness requirements.
1. Provide only if indicated.

F. Extended Members: Extend end, corner and pull posts above top of chain-link fabric 12 inches or as required to attach barbed wire assemblies.

2.4 TENSION WIRE

A. General: Provide horizontal tension wire at the following locations:
1. Location: Extended along bottom of fence fabric, unless otherwise noted.

B. Metallic-Coated Steel Wire: 0.177 inch diameter, marcelled tension wire complying with ASTM A 817/A 824 and the following:
1. Coating: Type I, aluminum coated (aluminized)
a. Class 2: Not less than 1.2 oz./sq.ft. of uncoated wire surface.

2.5 SWING GATES (CHAIN-LINK)

A. General: Comply with ASTM F 900 for the following swing-gate types:
1. Single gate.
2. Double gate.

B. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1083 and ASTM F 1043 for materials and protective coatings.

C. Frames and Bracing: Fabricate members from round tubing with outside dimension and weight according to ASTM F 900.

D. Frame Corner Construction: As follows:
   1. Welded.

E. Gate Posts: Fabricate members from round galvanized steel pipe with outside dimension and weight according to ASTM F 900 for the following gate fabric heights and leaf widths:
   1. Gate leaf up to 6 feet wide.
      a. IA: 2.875 inch o.d. with 0.203-inch wall, 5.79 lbs. per lineal foot.
      b. IC: 2.875 inch o.d. with 0.160-inch wall, 4.64 lbs. per lineal foot.
   2. Gate leaf over 6 to 13 feet wide
      a. IA: 4 inch o.d. with 0.226-inch wall, 9.10 lbs. per foot.
      b. IC: 4 inch o.d. with 0.160-inch wall, 6.56 lbs. per foot.
   3. Gate leaf over 13 to 18 feet wide.
      a. IA: 6.625 inch o.d. with 0.280-inch wall, 18.97 lbs. per foot.
   4. Gate leaf over 18 feet wide.
      a. IA: 8.625 inch o.d. with 0.322-inch wall, 28.55 lbs. per foot.
   5. Gateposts shall be equipped with tops so designed to exclude moisture from the post.

F. Hardware: Latches permitting operation from both sides of gate, hinges, center gate stops and, for each gate leaf more than 5 feet wide, keepers. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
   1. Hinges: Shall be adequate strength for gate, and with large bearing surfaces for clamping in position. The hinges shall not turn or twist under that action of the gate. The gates shall be capable of being opened and closed easily by one person. Hinges will be designed with offset arms to permit a 180-degree swing. Provide one pair hinges for each gate leaf.
   2. Latch: Shall have a padlock eye or provision for padlocking (one padlock for locking both gate leaves), and shall permit single gate to swing only in one direction. Latches shall be forked-type for single gates and forked-type plunger bar for double gates to permit operation from both sides of gate. The plunger rod shall be a minimum 1-3/8 inch o.d. The center of the latch is to be 3 feet above grade.
   3. Stops: Center stops for double gates shall consist of a device arranged to be set in concrete and to engage the plunger bar of the latch. Stop is to be a mushroom type or flush plate with anchors.
   4. Keeper: Provide keepers for each gate leaf over 5 feet wide, which shall consist of a mechanical device for securing the free end of the gate when in a full open position. All vehicle or drive gates shall be equipped with "semi-automatic" outer catches to secure gate in open position (automatically holds gate in the open position until manually released).
   5. Hardware for Pool Units: Provide Stanley regular weight 2-knuckle ball bearing size 4-1/2 inches by 3-1/2 inches left hand. Latch shall be swinging and sliding door latch.

2.6 GATE EXIT HARDWARE:

A. BNMA A156.3, Grade 1, Type 1 (rim exit device), with push pad actuating bar, suitable for exterior use.
   1. Function: 04 – Entrance by trim when latch bolt is released by key or set in a retracted position by key.
   2. Mounting Channel: Bent-plate channel formed from 1-1/8-inch thick, aluminum plate. Channel spans gate frame. Exit device is mounted on channel web, recessed between flanges extending 1/8 inch beyond push pad surface.

2.7 CAST-IN-PLACE CONCRETE

A. General: Comply with ACI 301 for cast-in-place concrete.

B. Materials: Portland cement complying with ASTM C 150 Type I or III, aggregates complying with ASTM C 33, and potable water for ready-mixed concrete complying with ASTM C 94. Measure, batch, and mix Project-site-mixed concrete according to ASTM C 94.
   1. Concrete Mixes: Normal-weight concrete air entrained with not less than 3000-psi compressive strength (28 days), 3-inch slump, and 1-inch maximum size aggregate.

2.8 POLYMER FINISHES

A. Supplemental Color Coating: Where called for, In addition to specified metallic coatings for steel, provide fence components with polymer coating.

B. Metallic-Coated Steel Tension Wire: PVC-coated wire complying with ASTM F 1664, Class 2b.

C. Fittings, Post and Line Caps, Rail and Brace Ends, Top Rail Sleeves, Tension and Brace Bands, Tension Bars, Truss Rod Assemblies, Barbed Wire Arms, Clips, and Fasteners: Comply with ASTM F 626 for polymer coating applied to exterior surfaces and, except inside cap shapes, to exposed interior surfaces.
   1. Polymer Coating: Not less than 10 mil thick PVC.
   2. Color: To match chain-link fabric complying with ASTM F 934, unless otherwise noted.

2.9 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

2.10 FENCE GROUNDING

A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
   1. Material Above Finished Grade: Copper or aluminum.
   2. Material On or Below Finished Grade: Copper.
   3. Bonding Jumpers: Braided copper tape, 1 inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.

B. Connectors and Grounding Rods: Comply with UL 467
   1. Connectors for Below-Grade Use: Exothermic welded type.
   2. Grounding Rods: Copper-clad steel, 5/8-inch by 96 inches.

2.11 PRIVACY SLATS

A. Material: Polyethylene tubular slats, not less than 0.023 inch thick, manufactured for chain-link fences from virgin polyethylene containing UV inhibitor, sized to fit mesh specified for direction indicated; with vandal-resistant fasteners and lock strips; with fins for increased privacy factor.

B. Color: As selected by A/E from manufacturer's full range or as indicated on drawings.

2.12 PIPE GATE

A. Materials
   1. Steel Plates, Shapes, and Bars: ASTM A 36.
   2. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
   3. Steel Pipe: ASTM A 53, heavy weight (Schedule 80), unless another weight is indicated or required by structural loads.
   4. Iron Castings: ASTM A 47, Grade 32510 malleable iron or ASTM A 48, Class 30 gray iron.
   5. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
   6. Galvanizing Repair Point: SSPC-Paint 20, high-zinc-dust-content paint for regalvanizing welds in steel.
   7. Fasteners: Type 304 or 316 stainless steel fasteners.

B. Fabrication: Connections, General: Use connections that maintain structural value of joined pieces.
   1. Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of basic metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.
   2. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes.

C. Hardware: Latches permitting operation from both sides of gate, hinges, center gate stops, and for each gate leaf more than 5 feet wide, keepers. Fabricate latches with integral eye openings for chain and padlocking.

D. Finish metal fabrications after assembly. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.13 COLLAPSIBLE STEEL BOLLARDS

A. Heavy-Duty Lockable Collapsible Steel Bollard, 4-inch outside diameter, schedule 40, as manufactured by Bollardsnsleeves.com, 1(800)914-4771. https://www.bollardsleeves.com/collapsible-locking-bollard/

B. Prime coat and two coats of exterior enamel, color as selected by architect.

C. Installed with reinforced concrete footing meeting manufacturer guidelines and required frost protection for project location.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance.
   1. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.

B. Top rail to be bent into smooth continuous arcs with smooth tangential transitions. Plan top rail section lengths and locate line post to achieve smooth arcs with secure connections of the top rail pipe sections.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
   1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
   2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
      a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water, unless otherwise noted.
      b. Concealed Concrete, where indicated: Top 2 inches below grade as indicated on Drawings to allow covering with surface material.
      c. Posts Set into Concrete in Sleeves, where indicated only: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
      d. Posts Set into Voids in Concrete, Contractor’s option: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
   3. Dimensions and Profile: As indicated hereinafter, unless otherwise noted on Drawings.
      a. Size of Footings: Concrete is to extend a minimum of 6 inches below bottom of post. Typical footings shall be as follows (see note under Installation for deeper excavations as required in loose soils and for posts with heavy lateral loads).
         1) Intermediate posts up to 10 feet high: minimum 12 inch diameter by 3'-6" below grade.
         2) Intermediate posts 10 feet high and above: minimum 14 inch diameter by 3'-6" below grade.
         3) End, corner, pull posts under 6 feet: minimum 14 inch diameter by 3'-6" below grade.
         4) End, corner, pull posts 6 feet to 10 feet: minimum 18 inch diameter by 3'-6" below grade.
         5) End, corner, pull posts above 10 feet: minimum 18 inch diameter by 4'-2" below grade.
         6) Gate posts under 6 feet wide leaf: minimum 14 inch diameter by 4'-6" below grade.
         7) Gate posts 6 feet to 13 feet wide leaf: minimum 18 inch diameter by 4'-6" below grade.
         8) Gate posts 13 feet to 18 feet wide leaf: minimum 24 inch diameter by 4'-6" below grade.
         9) Softball backstop (12 feet high back, 20 feet high opening): minimum 18 inch diameter by 4'-2" below grade.

C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more, unless otherwise indicated.

D. Line Posts: Space line posts uniformly at 10 feet o.c., unless otherwise noted.

E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.
   1. Locate horizontal braces at midheight of fabric 6 feet or higher, on fences with top rail and at 2/3 fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric.
   1. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

H. Intermediate and Bottom Rails: Install, spanning between posts, where indicated or required for performance.

I. Chain-Link Fabric: Apply fabric to outside of enclosing framework, unless otherwise indicated. Leave 2 inches between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
   1. At tennis courts, apply fabric inside of enclosing framework and leave 1 inch gap between top of playing surface and bottom of selvage.

J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.

K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at 1 end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
   1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

M. Privacy Slats: Install slats in direction indicated, securely locked in place.
   1. Diagonally,

3.5 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 GROUNDING AND BONDING

A. Fence Grounding: Install at fences 10 feet and over, at maximum intervals of 1500 feetexcept as follows:
   1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
      a. Gates and Other Fence Openings: Ground fence on each side of opening.
         1) Bond metal gates to gate posts.
         2) Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.

C. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at the grounding location.

D. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

E. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
   4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

F. Bonding to Lightning Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor complying with NFPA 780.

3.7 ADJUSTING

A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION 32 31 13

SECTION 32 93 00 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Trees
   2. Shrubs
   3. Ground cover
   4. Plants
   5. Tree stabilization
   6. Edgings
   7. Rounded Landscape Stone

B. Related Sections:
   1. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
   2. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
   3. Division 32 Section "Turf and Grasses" for lawn planting.
   4. Division 33 Section "Subdrainage" for below-grade drainage of landscaped areas, paved areas, and wall perimeters.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than sizes indicated; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.

D. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.

E. Clump: Where three or more young trees were planted in a group and have grown together as a single tree having three or more main stems or trunks.

F. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.

G. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.

H. Finish Grade: Elevation of finished surface of planting soil.

I. Manufactured Topsoil: Screened soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

J. Multi-Stem: Where three or more main stems arise from the ground from a single root crown or at a point right above the root crown.

K. Planting Soil: Screened native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

L. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

M. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

N. Vegetative Plug: Plant grown in its own separate cell of soil.

O. Bulb: Short stem with fleshy leaves or leaf bases.

1.4 SUBMITTALS

A. Quality Assurance/Control Submittals:
1. Product Data: For each type of product indicated.
2. Qualification Data: For qualified landscape Installer.
3. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
   a. Manufacturer's certified analysis for standard products.
   b. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
4. Material Test Reports: For existing surface soil and imported topsoil.
5. Planting Schedule: Indicating anticipated planting dates for exterior plants.

B. Closeout Submittals:
1. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.
2. Warranty: Sample of special warranty.

C. Soil amendments list and quantities for each type of planting.

D. Plant source for all plantings prior to installation.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.
1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
1. Report suitability of topsoil for plant growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
2. Provide written agreement to follow stated recommendations for soil amendment.

D. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
   1. Selection of exterior plants purchased under allowances will be made by Architect, who will tag plants at their place of growth before they are prepared for transplanting.

E. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above the ground for trees up to 4-inch caliper size, and 12 inches above the ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

F. Observation: Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
   1. Notify Architect in writing of sources of planting materials seven days in advance of delivery to site.

G. Preinstallation Conference: Conduct conference at Project site, prior to installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver exterior plants freshly dug.
   1. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

B. Do not prune trees and shrubs before delivery except as approved by Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery and handling.

C. Handle planting stock by root ball.

D. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.
   1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
   2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
   3. Do not remove container-grown stock from containers before time of planting.
   4. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.7 PROJECT CONDITIONS

A. Protection After Delivery: Cover the balls of "B & B" plants, which cannot be planted immediately on delivery with moist soil, mulch, or other protection from drying winds and sun. Plant bare-rooted plants or heel-in immediately upon delivery. Water plants as necessary until planted.

B. Time of Planting: Conduct planting operations under favorable weather conditions during the next season or seasons, which are normal for such work as determined by accepted practice in the locality of the Project. Seasons for these plantings are: spring planting, March 10 through May 10, fall planting, August 20 through November 30.

C. Substitutions: Substitutions will be permitted only upon submission of proof that a plant is not obtainable locally and an authorization by the Architect in the form of a change order providing for use of the nearest equivalent obtainable size or variety of plant having the same essential characteristics with an equitable adjustment of contract price.

1.8 WARRANTY

A. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
      b. Structural failures including plantings falling or blowing over.
      c. Faulty operation of tree stabilization, edgings, and tree grates.
      d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Periods from Date of Substantial Completion:
      a. Warrant plants for the duration of one full growing season after planting and shall be alive and in satisfactory growth at the end of the warranty period. The growing season is defined as one full year after acceptance of planting, in writing, but not before Substantial Completion.
   3. Include the following remedial actions as a minimum:
      a. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
      b. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
      c. Provide extended warranty for replaced plant materials; warranty period equal to original warranty period.
      d. A limit of one replacement of each exterior plant will be required in each warranty period except for losses or replacements due to failure to comply with requirements.

1.9 MAINTENANCE SERVICE

A. Begin maintenance immediately following the last operation of installation for each plant and shall continue in accordance with the following requirements:
   1. Protect new planting and maintain for a period of 60 days. This includes all labor and material. Following the 60 day Contractor maintenance period and acceptance in writing by the Landscape Architect, the Owner will assume maintenance of the planting or accepted portion of planting accepted. Maintenance shall include watering, weeding, cultivating, mulching, tightening and repairing of guys, removal of dead material, resetting of plants to proper grades or upright position, and restoration of the planting saucer, and other necessary operations. If planting is done after lawn preparation, proper protection to lawn areas shall be provided and damage resulting from planting operations repaired promptly.

B. Labor, Equipment, and Supervision for Maintenance
   1. Following the 60-day maintenance period, the Contractor for the Work under this Section shall supply all necessary supervision to meet the requirements set forth under this Section. It is understood that the Owner will furnish the necessary labor and watering equipment in accordance with this Contractor's instructions, to meet the requirements herein established.
   2. The Owner is to supply the necessary hoses and other equipment required for watering. The Contractor for the Work under this Section will be responsible for instructing the personnel assigned and supervising their Work, until he is satisfied that they fully understand the requirements. He shall also make frequent observations to determine whether instructions and maintenance work has been properly carried out, and report to the Architect circumstances which he feel is detrimental to the growth and protection required during the maintenance period.

3. Nothing in this Section shall relieve the Contractor of the Work under this Section from the warranty provisions hereinafter set forth, unless he has given proper notice to the Architect, as called for, and then only if it can be clearly shown that negligence and improper following of instructions had been the cause of such failures as are covered under the warranty.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Shown on the planting plan.

C. Plant materials as scheduled on the Drawings and these Specifications, conform by name to "Standardized Plant Names," current edition, and accepted nursery trade.
1. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

D. Furnish quantities necessary to complete the planting as shown and located on the Drawings.

E. Plants shall have a habit of growth that is normal for the species and shall be sound, healthy, vigorous, and free from insect pests, plant diseases, and injuries. Plants shall equal or exceed the measurements specified in the plant list, which are minimum acceptable sizes. They shall be measured before pruning with branches in normal position. Necessary pruning shall be done at time of planting. Requirements for the measurement, branching, grading, quality, balling, and burlapping of plants in the plant list generally follow the code of standards currently recommended by the American Association of Nurserymen, Inc. in The American Standard for Nursery Stock.

F. Trees shall have straight trunks with the leader intact, undamaged, and uncut. Old cuts or abrasions shall be completely calloused over. Branching must be well developed and not one sided.

G. Plants are subject to observation for quality, size, and color. Plants that are weak or sick or lacking compact and proper proportions will not be accepted. Plants shall not be pruned prior to delivery.

2.2 PERENNIAL PLANT MATERIAL

A. General: Furnish nursery-grown perennials complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Shown on the planting plan.

C. Plant materials as scheduled on the Drawings and these Specifications, conform by name to "Standardized Plant Names," current edition, and accepted nursery trade.
1. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of perennial required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots.

D. Furnish quantities necessary to complete the planting as shown and located on the Drawings.

E. Plants shall have a habit of growth that is normal for the species and shall be sound, healthy, vigorous, and free from insect pests, plant diseases, and injuries. Plants shall equal or exceed the measurements specified in the plant list, which are minimum acceptable sizes. Plants in the plant list generally follow the code of standards currently recommended by the American Association of Nurserymen, Inc. in The American Standard for Nursery Stock.

F. Plants are subject to observation for quality, size, and color. Plants that are weak or sick or lacking compact and proper proportions will not be accepted.

2.3 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 6 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth. Topsoil either salvaged on site or imparted is to be screened and or pulverated prior to placement.
   1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Screen surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
      a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from bogs or marshes.
   2. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Screen surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
      a. Surface soil may be supplemented with imported or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from bogs or marshes.

2.4 INORGANIC SOIL AMENDMENTS

A. General: Use any of the following soil amendments as recommended by “topsoil analysis” to produce topsoil suitable for plant growth.

B. Lime: ASTM C 602, agricultural limestone containing a minimum of 80 percent calcium carbonate equivalent and as follows:
   1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
   2. Provide lime in form of dolomitic limestone.

C. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

D. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

E. Aluminum Sulfate: Commercial grade, unadulterated.

F. Perlite: Horticultural perlite, soil amendment grade.

G. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.

H. Sand: Clean, washed, natural or manufactured, free of toxic materials.

2.5 MULCHES

A. Organic Shredded Hardwood Bark Mulch: Well aged and free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood bark, aged 1 full year.

2.6 WEED-CONTROL BARRIERS

A. Herbicide: Apply herbicide to all planting beds prior to planting. Verify 100 percent kill of existing plant materials. Reapply if necessary.

B. Preemergent Herbicide: Apply slow release pre-emergent herbicide to exposed topsoil in planting beds prior to mulching. Protect installed plantings during application. Use only pre-emergent herbicides that are compatible with bulbs.

2.7 TREE STABILIZATION MATERIALS

A. Stakes and Guys:
1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.
3. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch in diameter.
4. Hose Chafing Guards: Reinforced rubber or plastic hose at least 1/2 inch in diameter, black, cut to lengths required to protect tree trunks from damage.
5. Guy Cables: 5-strand, 3/16-inch- diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.
6. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

2.8 LANDSCAPE EDGINGS

A. Cut Edge: Where landscape planting bed meets lawn, provided sharply cut clean edge of planting bed with a well formed outline.

2.9 ROUNDED LANDSCAPE STONE

A. Washed rounded river stone, ¾” diameter nominal. Free of soil and debris.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before planting. Make minor adjustments as required.

D. Lay out exterior plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
   1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING BED ESTABLISHMENT

A. All existing plant materials (weeds and grasses) are to be treated with herbicide and then removed after a complete kill.

B. Existing topsoil to be used shall be prepared by thoroughly mixing in organic matter at a rate of 1/3 volume of soil replaced to planting pits. Forms of slow-release fertilizer can be used if recommend due to topsoil analysis and reviewed by A/E.

C. Except for ericaceous plants, very acid or sour soil, having a pH of less than 6, shall be thoroughly mixed with sufficient lime to produce a slightly acid reaction (a p^H of 6 to 6.5).

D. Excess excavated soil shall be disposed of offsite, unless otherwise noted.

3.4 PERENNIAL AND BULB PLANTING

A. Existing topsoil to be used shall be prepared by thoroughly mixing in organic matter at a rate of 1/3 volume of soil the 1 foot soil depth. Slow-release fertilizer can be used if recommend due to topsoil analysis and reviewed by A/E.

B. Aged cow manure is to be added to the soil in the area of the bulb plantings.

C. Plant bulbs September 15 – October 10. Strictly adhere to this timing.

D. Place hardwood bark mulch after completion of bulb planting. Use only pre-emergent herbicides that are compatible with bulbs.

3.5 PLANTING PITS

A. Exercise reasonable care to have pits dug and soil prepared prior to moving plants to their respective locations for planting. Excavate circular pits with vertical sides for all plants, except for hedge and plants specifically designated on the plans to be planted in beds. Diameter of pits for trees shall be at least 2 feet greater than the ball diameter, and B & B shrubs and vines shall be at least one foot greater than the diameter of the ball or spread of roots. Diameter of pits for bare-rooted ("BR") shrubs and vines shall be at least one foot greater than the spread of roots. The depth of pits for trees, shrubs, and vines shall be enough to accommodate the ball or roots when the plant is set to finished grade, allowing for 6 inches of new compacted prepared topsoil in the bottom of the pit.

3.6 SETTING PLANTS

A. Unless otherwise specified, plant plants in pits, centered, and set on 6 inches of compacted prepared topsoil to such a depth that the finished grade level of the plant after settlement will be the same as that at which the plant was grown or slightly higher. Plant them upright and face to give the best appearance or relationship to adjacent structures. Do not pull burlap out from under the balls. Remove platforms, wire, and surplus binding from top and sides of the balls. Spread roots in their normal position. Cut off broken or frayed roots cleanly. Place prepared topsoil and compact carefully to avoid injury to roots and to fill voids. When the hole is nearly filled, add water as necessary and allow it to soak away. Fill the hole to finished grade and form a shallow saucer around each plant by placing a ridge of topsoil around the edge of each pit. After the ground settles, fill additional topsoil into the hole to the level of the finished grade.

B. The topsoil used for backfilling around plants shall be of a proper type and formula to insure proper maintenance and growth of the plants set. Where plantings will be in clay, the size of the pit and the amount of backfilling shall be of sufficient size and quantity so as to provide a proper growth environment; and to sustain life and growth for all of the growing materials called for.

3.7 TREE AND SHRUB PLANTING

A. Trunk Wrapping: Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping. Wrap trees of 2-inch caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. The wrap shall be neat and snug with suitable cord holding it in place at top and bottom and at any other place necessary to maintain the wrapping in place. Wrap trees between November 1 and March 1. Wrapping shall be removed from March 1 to November 1.

3.8 TREE AND SHRUB PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees and shrubs as directed by Architect.

C. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character.

3.9 TREE STABILIZATION

A. Trunk Stabilization: Unless otherwise indicated, provide trunk stabilization as follows:
1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend one third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
2. Use 2 stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; 3 stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
3. Support trees with two strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

B. Guying and Staking: Guy and stake trees exceeding 14 feet in height and more than 3 inches in caliper unless otherwise indicated. Securely attach no fewer than 3 guys to stakes 30 inches long, driven to grade.
1. For trees more than 6 inches in caliper, anchor guys to pressure-preservative-treated deadmen 8 inches in diameter and 48 inches long buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
2. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
3. Attach flags to each guy wire, 30 inches above finish grade or paint turnbuckles with luminescent white paint.

3.10 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants 18 inches apart.

B. Dig holes large enough to allow spreading of roots and backfill with planting soil.

C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.11 PLANTING BED MULCHING

A. Apply weed-control herbicides before mulching according to manufacturer's written instructions. Completely cover area to be mulched.

B. Mulch backfilled surfaces of planting beds and other areas indicated. Provide mulch ring around trees in lawn areas.
   1. Organic Mulch: Apply 3-inch average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.12 ROUNDED LANDSCAPE STONE

A. Landscape stone to be set 6” depth minimum over nonwoven geotextile fabric. Keep stone free of contamination by soils, lawn cuttings and other debris until final acceptance.

3.13 PLANT MAINTENANCE

A. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, adjusting and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.

B. Ground Cover and Plant Maintenance: Maintain and establish plantings by watering, weeding, fertilizing, mulching, and other operations as required to establish healthy, viable plantings.

3.14 FIELD QUALITY CONTROL

A. The Architect will make observation of the work of planting to determine completion of Contract Work, exclusive of the possible replacement of plants, at the conclusion of the maintenance period upon written notice requesting such observation, submitted by the Contractor at least 10 days prior to the anticipated date.

B. Acceptance: After observation the Owner will notify the Contractor in writing, countersigned by the Architect, of acceptance of the Work of this Section, exclusive of the possible replacement of plants subject to warranty or if there are deficiencies of the requirements for completion of the Work.

3.15 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

3.16 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 32 93 00

SECTION 32 13 13 – SITE CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:
   1. Misc. concrete slabs
   2. Drives
   3. Walkways
   4. Curbs
   5. Tactile Warning Plates

B. Related Sections include the following:
   1. Division 03 Section "Cast-in-Place Concrete, Miscellaneous Cast-in-Place Concrete" for general building applications of concrete.
   2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
   3. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

A. Quality Assurance/Control Submittals:
   1. Product Data: For each type of manufactured material and product indicated.
   2. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   3. Qualification Data: For manufacturer and testing agency.
   4. Field quality-control test reports.
   5. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

E. Concrete ramps and curbs shall be provided to conform to the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local Regulations. These requirements supersede Technical Specifications in this Section.
   1. Detectable warnings shall conform to ADAAG, Articles 4.7.7 and 4.29.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
   1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete producer.
      d. Concrete pavement subcontractor.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement, when applicable.

B. Collect unused reinforcing steel and place in designated area for recycling.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Products: Subject to compliance with requirements, provide one of the products specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the Substitution Request Form” and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
   1. Use flexible or curved forms for curves with a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

D. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

E. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

F. Plain Steel Wire: ASTM A 82, as drawn.

G. Deformed-Steel Wire: ASTM A 496.

H. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

I. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

J. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

K. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

L. Zinc Repair Material: ASTM A 780.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:
   a. Portland Cement: ASTM C 150, Type I or III,gray

B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.
   1. Maximum Coarse-Aggregate Size: 1 inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
   1. Products:
      a. Axim Concrete Technologies; Cimfilm.
      b. Burke by Edeco; BurkeFilm.
      c. ChemMasters; Spray-Film.
      d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
      e. Dayton Superior Corporation; Sure Film.
      f. Euclid Chemical Company (The); Eucobar.
      g. Kaufman Products, Inc.; Vapor Aid.
      h. Lambert Corporation; Lambco Skin.
      i. L&M Construction Chemicals, Inc.; E-Con.
      j. MBT Protection and Repair, ChemRex Inc.; Confilm.
      k. Meadows, W. R., Inc.; Sealtight Evapre.
      l. Metalcrete Industries; Waterhold.
      m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
      n. Sika Corporation, Inc.; SikaFilm.
      o. Symons Corporation; Finishing Aid.
      p. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
   1. Products:
      a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
      b. Burke by Edoko; Aqua Resin Cure.
      c. ChemMasters; Safe-Cure Clear.
      d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
      e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
      f. Euclid Chemical Company (The); Kurez DR VOX.
      g. Kaufman Products, Inc.; Thinfilm 420.
      h. Lambert Corporation; Aqua Kure-Clear.
      i. L&M Construction Chemicals, Inc.; L&M Cure R.
      j. Meadows, W. R., Inc.; 1100 Clear.
      k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
      l. Symons Corporation; Resi-Chem Clear.
      m. Tamms Industries Inc.; Horncure WB 30.
      n. Unitex; Hydro Cure 309.
      o. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Penetrating Anti-Spalling Sealer: Sealer shall be a siloxane-based compound which has a 92 percent chloride ion screen and a repellency factor of 92 percent when tested in accordance with NCHRP #244, Test Method. In addition, sealer-treated concrete must exhibit no scaling when exposed to 125 cycles of freezing and thawing. System shall conform to requirements with ASTM C957-81. Tests must be by an independent testing laboratory.
   1. Products: Subject to compliance with requirements, provide products by one of the following:
      a. Euco-Guard Vox (VOC Compliant); Euclid Chemical Co.
      b. Environseal; Hydrozo.
      c. Saltguard WB; PROSOCO, Inc.
      d. Aquapel Plus; L & M Construction Chemical Co.

2.7 DETECTABLE WARNING PLATES

A. Cast Iron Detectable Warning Plates: Manufactured in accordance with the requirements set forth in the Americans with Disabilities Act (ADA). Tiles are to be designed to be cast in place. Cast Gray Iron materials to ASTM A-48, Class 30a Cast.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Neenah Foundary Company, Model R-4984-240LT, Qucik Connect
      b. EJCO, Model Duralast Tactile Warning Plates
      c. Reliance Foundary, Model R-4984-24Q Cast Iron Detectable Warning Plate

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): Refer to Concrete Schedule.
   2. Maximum Water-Cementitious Materials Ratio at Point of Placement: Refer to Concrete Schedule.
   3. Slump Limit: 4 inches, plus or minus 1 inch.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
   1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing admixture, high-range, water-reducing admixture, high-range, water-reducing and retarding admixture, plasticizing and retarding admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements as follows:
   1. Fly Ash or Pozzolan: 25 percent.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete, unless otherwise noted: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
   1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
   2. Provide tie bars at sides of pavement strips where indicated.
   3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
   4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
   1. Locate expansion joints at intervals not to exceed 50 feet or as noted on plans.
   2. Extend joint fillers full width and depth of joint.
   3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
   4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
   5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes to provide a “tooled and traced” or “window pane” appearance, unless otherwise noted. Eliminate groover marks on concrete surfaces.
   2. Sawed Joints: Do not saw cut joints.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site.

F. Do not add water to fresh concrete after testing.

G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

I. Screed pavement surfaces with a straightedge and strike off.

J. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

K. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

L. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.8 FORMWORK

A. General: See section 033000 for formwork and finishing of vertical exposed surfaces. Final surfaces shall have a smooth rubbed finish.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
   1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

F. Apply anti-spalling sealer per Manufacturer’s installation instructions and recommendations.

3.10 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:
   1. Elevation: 1/4 inch.
   2. Thickness: Plus 3/8 inch, minus 1/4 inch.
   3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
   4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
   5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
   6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
   7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
   8. Joint Spacing: 3 inches.
   9.
   10. Contraction Joint Depth: Plus 1/4 inch, no minus.
   11. Joint Width: Plus 1/8 inch, no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
    a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 92 00 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Sodding
   2. Lawn renovation.
   3. Erosion-control materials.

B. Related Sections:
   1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling and for soil erosion and sedimentation control that may affect the Work of this Section.
   2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, topsoil placement and finish grading.
   3. Division 33 Section "Subdrainage" for subsurface drainage.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Manufactured Soil: Screened soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments and perhaps fertilizers to products a soil mixture best for plant growth.

D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

E. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

F. Topsoil: Plant growth medium cleaned of debris, roots, rocks, soils clumps, weeds and other non-soil contaminants prior placement,.

G. Lawn Maintenance: All materials and operations necessary to establish and maintain a healthy stand of turf following initial seeding operations. Including but not limited to, mowing, fertilization, watering and treatment for weeds, fungus and disease as needed. Maintenance remains responsibility of Contractor until Project closeout or a minimum of one full growing season.

1.4 SUBMITTALS

A. Quality Assurance/Control Submittals:
   1. Product Data: For each type of product indicated.
   2. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
   3. Qualification Data: For qualified landscape Installer.
   4. Product Certificates: For soil amendments and fertilizers from manufacturer.

5. Material Test Reports: For existing surface soil and imported topsoil.
6. Planting Schedule: Indicating anticipated planting dates for each type of planting.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.
   1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
   1. Report suitability of topsoil for lawn growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.

D. Requirements of Regulatory Agencies: Comply with all Federal and State laws governing fertilizers.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

B. Bulk Materials
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas on plants.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

1.7 PROJECT CONDITIONS

A. Contractor shall notify A/E, in writing, when Work on this Project has progressed sufficiently to commence work of seeding. Thereafter, seeding operations shall be conducted under favorable weather conditions during next season or seasons, which are normal for such work as determined by accepted practice in locality of Project. At option and on full responsibility of Contractor, seeding operations may be conducted under unseasonable conditions without additional compensation. Contractor is to provide in writing to the CM and AE a watering and maintenance schedule including a listing of water sources prior to conducting seeding operations out of season.

1.8 SCHEDULING

A. Planting Restrictions: Plant during one of following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of seeding.
   1. Spring Planting: May 1, beginning date.
   2. Fall Planting: October 1, ending date.

3. Summer Planting: June 15 through September 1, when water is available. Submit maintenance schedule and water source in writing prior to seeding.
4. Sod Installation:
    a. Spring Planting: May 1, through June 15.
    b. Fall Planting: September 1 through October 15

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be preformed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

C. Irrigation: Do not begin seeding operations until some type irrigation system is in place and operating to provide uniform coverage of all areas to receive seed.

1.9 MAINTENANCE

A. Begin maintenance of lawns immediately after each area is planted and continue until acceptable lawn is established, but not for less than the following periods:
1. Sodded Lawns: Maintenance remains responsibility of Contractor until Project close out or a minimum of one full growing season.

1.10 WARRANTY AND REPLACEMENT

A. Warranty: Lawns shall be warranted for minimum duration of one full year, to include one full growing season after seeding, and shall be alive and in satisfactory growth at end of warranty period. Growing season is defined as beginning May 1 and ending October 1.

B. Replacement: At end of warranty period, A/E upon written notice requesting such inspection, submitted by Contractor at least 10 days before anticipated date, will make observation. If lawns do not show a healthy, uniform stand of grass, those areas shall be reseeded as soon as conditions permit, but during spring or fall seeding periods.

C. Architect/Engineer will observe seeded areas within one-year warranty. Seeded areas requiring replacement during warranty period shall be warranted one additional full year from date of reseeding.

D. Owner's Responsibility: If an area of seeding during warranty and replacement period is found to be damaged or destroyed due to vandalism, malicious mischief, vehicle ruts and tracks, or acts of God such as flooding, storm debris, then Owner will have responsibility of replacing those lawn areas without cost or responsibility to Contractor.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Sod: Certified, complying with TPI's "Specifications for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted. The sod shall not contain netting.

B. When delivered, the sod is to be strongly rooted, and free of pernicious weeds. It shall be mowed to a height not to exceed 3 inches before lifting and shall be of uniform thickness with not less than 1 inch of soil.

C. Turfgrass Species:
1. Sod species: Proportioned by weight as follows:
    a. 100 percent Elite Kentucky Bluegrass (Poa pratensis)
        1) Three Varieties (35/35/30 blend.)

D. Turfgrass Sod: Roll sod shall be minimum 24” width and each roll a minimum of 8 square feet in area.

2.2 TOPSOIL

A. Topsoil (Planting Soil): ASTM D 5268, pH range of 5.5 to 7, a minimum of 6 percent organic material content; screened to be free of stones 1 inch or larger in any dimension and other extraneous materials.

2.3 INORGANIC SOIL AMENDMENTS

A. General: Use any of the following soil amendments as recommended by “topsoil analysis” to produce topsoil suitable for lawn growth.
   1. Lime: ASTM C 602, agricultural limestone containing a minimum of 80 percent calcium carbonate equivalent and as follows:
      a. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
      b. Provide lime in form of dolomitic limestone.
   2. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
   3. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
   4. Aluminum Sulfate: Commercial grade, unadulterated.
   5. Perlite: Horticultural perlite, soil amendment grade.
   6. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.
   7. Sand: Clean, washed, natural or manufactured, free of toxic materials.
   8. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
   9. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.4 ORGANIC SOIL AMENDMENTS (DO NOT USE)

2.5 FERTILIZER

A. Fertilizer: Commercial fertilizer shall be used for initial preparation and shall conform to applicable state fertilizer laws. Use of organic lawn fertilizer shall be used for surface application after grass is up. Fertilizer shall be uniform in composition, dry and free flowing, and shall be delivered to site in original, unopened containers, each bearing manufacturer's guaranteed analysis. Fertilizer, which becomes caked or otherwise damaged, making it unsuitable for use, will not be acceptable. Commercial-grade complete fertilizer of neutral character, consisting of fast and slow release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium.

2.6 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew, weed, and seed-free, threshed straw of wheat, rye, oats, or barley.

B. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.7 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
   3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   4. Uniformly moisten excessively dry soil.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect grade stakes set by others until directed to remove them.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LAWN PREPARATION

A. Apply fertilizer and soil amendments directly to spread topsoil per results of topsoil analysis.
   1. Thoroughly blend planting soil mix
      a. Delay mixing fertilizer with planting soil if planting will not proceed within a three days.
      b. Mix lime with dry soil before mixing fertilizer.

B. Unchanged Subgrades (7 months or greater): If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
   1. Strip existing grass, vegetation, and turf. Do not mix into surface soil.
   2. Loosen surface soil to a depth of at least 6 inches.
   3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
   4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
   5. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
      a. Apply fertilizer and soil amendments directly to surface soil before loosening per results of topsoil analysis.
   6. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

C. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface ponding to soak in before planting. Do not create muddy soil.

D. Before planting, restore areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Lawn Preparation" Article.

B. For erosion-control blanket or mesh, install as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

C. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
   1. Lay sod perpendicular to angle of slopes.
   2. Anchor sod with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per 6 SF of sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.6 LAWN RENOVATION

A. Renovate existing lawn.

B. Renovate existing lawn. This includes both existing damage caused by settlement, poor maintenance and over use as well as damage caused by the Contractor's operations such as storage of materials or equipment and movement of vehicles.
   1. Reestablish lawn where settlement or washouts occur or where minor regrading is required.
   2. Provide new topsoil as required.

C. Strip sod and vegetation from diseased or unsatisfactory lawn areas; do not bury in soil.

D. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.

E. Mow, dethatch, core aerate, and rake existing lawn.

F. Remove weeds before seeding. Where weeds are present, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and initial fertilizers required for establishing new lawns and mix thoroughly into top 4 inches of existing soil. Provide new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with straw mulch as required for new lawns.

K. Water newly planted areas and keep moist until new lawn is established.

3.7 LAWN MAINTENANCE

A. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn. Provide materials and installation the same as those used in the original installation.
   1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

B. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches.
   1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
   2. Water lawn with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Sodded Areas: : Begin maintenance immediately after each area is planted and continue until acceptance, but for not less than following periods:
   1. Sodded areas: Maintenance remains responsibility of Contractor until Project close out or a minimum of one full growing season.
   2. Maintain and establish sodded area by watering, weeding, fertilizing, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas. Provide materials and installation the same as those used in the original installation.
   3. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep seeded area uniformly moist to a depth of 4 inches.
      a. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
      b. Water seeded with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
   1. May – June — Every 3-4 days
   2. July – Early August — Every 5 days
   3. August – November — Every 3-4 days

E. Fertilization: Apply fertilizer after initial mowing and when grass is dry. Continue fertilization through maintenance period in accordance with following rates and schedule:

LAWN				
Date	Rate (lb. N/1000 ft2)	Fertilizer Ratio (N-P-K)	Examples to Purchase	Nitrogen Source
May 1-10th	0.75	1-0-1	25 0-25 20-0-20	>50% soluble Nitrogen
June 1-10th	0.5	1-0-1	25-0-25 20-0-20	>50% soluble Nitrogen
July 1-6th	0.75	1-0-0	33-0-0 35-5-4	<35% soluble Nitrogen
September 5-10th	1	1-1-1	12-12-12 19-19-19	<35% soluble Nitrogen
November 5-15th	1	1-0-0	33-0-0 Sulfur coated urea	<35% soluble Nitrogen

3.8 SATISFACTORY LAWNS

A. Lawn installations shall meet the following criteria as determined by Architect:
   1. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm)]

B. Sod installations shall meet the following criteria as determined by Architect:
   1. Satisfactory Sodded Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.

C. Use specified materials to reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris, created by lawn work, from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after lawn is established.

C. Remove nondegradable erosion-control measures after grass establishment period.

3.10 FIELD QUALITY CONTROL

A. Architect will make observation of the Work of lawns to determine completion of Contract work at conclusion of maintenance period, upon written notice requesting such observation submitted by Contractor at least 10 days prior to anticipated date. Architect will note condition of lawns and determine in writing whether maintenance shall continue.

END OF SECTION 32 92 00

DIVISION 33

UTILITIES

SECTION 33 05 00 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes following:
   1. Piping joining materials.
   2. Transition fittings.
   3. Sleeves.
   4. Grout.
   5. Flowable Fill
   6. Piped utility demolition
   7. Piping system common requirements.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. ABS: Acrylonitrile-butadiene-styrene plastic.

D. CPVC: Chlorinated polyvinyl chloride plastic.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 QUALITY ASSURANCE

A. Comply with NSF 61, “Drinking Water Systems Components – Health Effects,” for materials for potable water.

B. Comply with NFPA 24, “Installation of Private Fire Service Mains and their Appurtenances,” for materials, installation, tests, flushing and valve and hydrant supervision.

C. Water main testing shall be performed in accordance with local agency jurisdiction. Pressure testing – comply with AWWA (American Water Works Association) guidelines.

D. Utility Compliance: Comply with regulations pertaining to water distribution systems.

E. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

F. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

G. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of manufacturers specified.

B. Products of other manufacturers will be considered for acceptance provided they equal or exceed material requirements and functional qualities of specified product. Requests for A/E's approval must be accompanied by Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.2 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solvent Cements for Joining Plastic Piping:
   1. ABS Piping: ASTM D 2235.
   2. CPVC Piping: ASTM F 493.
   3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
   4. PVC to ABS Piping Transition: ASTM D 3138.

E. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.3 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings NPS 1-1/2 and Smaller:
   1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
   2. Aboveground Piping: Specified piping system fitting.

C. AWWA Transition Couplings NPS 2 and Larger:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of following:
      a. Cascade Waterworks Mfg. Co.
      b. Dresser, Inc.; DMD Div.
      c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
      d. JCM Industries.
      e. Smith-Blair, Inc.
      f. Viking Johnson.
   2. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

D. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of following:
      a. Cascade Waterworks Mfg. Co.
      b. Fernco, Inc.
      c. Mission Rubber Company.
      d. Plastic Oddities.
   2. Description: ASTM C 1173 with elastomeric sleeve ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.4 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Division 22 Section "Common Work Results for Plumbing."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.5 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.6 FLOWABLE FILL

A. Description: Low-strength-concrete, flowable-slurry mix.
   1. Cement: ASTM C 150, Type I, portland.
   2. Density: 115- to 145-lb/cu. ft.
   3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
   4. Aggregates: ASTM C 33, natural sand, fine.
   5. Admixture: ASTM C 618, fly-ash mineral.
   6. Water: Comply with ASTM C 94/C 94M.
   7. Strength: 100 to 200 psig at 28 days.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

A. Refer to Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING INSTALLATION

A. Install piping according to following requirements and Division 33 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by removable PE sleeves.

K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas [**2 inches**] <**Insert dimension**> above finished floor level.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
      a. **PVC** Pipe Sleeves: For pipes smaller than NPS 6.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to following requirements and Division 33 Sections specifying piping systems.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

D. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

E. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

F. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End PE Pipe and Fittings: Use butt fusion.
   2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

3.4 PIPING CONNECTIONS

A. Make connections according to following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.5 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 33 05 00

SECTION 33 05 10 - UTILITIES SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: General utility services, including but not limited to the following:
   1. Storm sewer pipe and tube.
   2. Concrete structures.
   3. Drainage castings.
   4. Water main piping.
   5. Natural gas LP piping.
   6. Sanitary sewer piping.
   7. Rip rap.
   8. Catch basins.
   9. Manholes.
   10. Inlets.
   11. Manhole frames and covers.
   12. Field verification.

B. Related Sections:
   1. Division 31 Section “Site Clearing”.
   2. Division 31 Section “Earth Moving”.
   3. Division 33 Section “Common Work Results for Utilities”.

1.3 DEFINITIONS

A. The term utilities as hereinafter stated or indicated is that part of the storm, sanitary, and water system beginning 5 feet from the outer face of the outside building wall, and conveying it to the local utility mains or other disposal terminals. Exceptions from the 5 foot dimension are extensions of the building drains and gas piping including the meter and regulator.

B. Site water lead/main includes, but is not limited to, the following:
   1. Providing water lead/main piping and fittings, valves, valve boxes, special connections, polyethylene wrap and related materials and labor adjunct to the completion of the site water main.
   2. Provide fire hydrants, Fire Department connection, and related materials and labor adjunct to the completion of the exterior fire protection system.

C. Site sanitary sewer work includes, but is not limited to, the following: Sewer drainage piping and fittings, manholes, sewer structures, and related materials and labor adjunct to the completion of the sanitary sewer system.

D. Site drainage work includes, but is not limited to, the following:
   1. Providing stormwater drainage pipe and fittings outside the buildings, new stormwater culverts, manholes, catch basins, perforated plastic underdrain systems, and related materials and labor adjunct to the completion of site drainage work.
   2. The Contractor for the Work under this Section will be responsible for installing or constructing special sewer structures that are a part of the storm drainage system.

E. The gas piping work includes, but is not limited to the following: Gas piping, locator wire from gas main to the meter regulator and related materials and labor adjunct to the completion of the gas piping system.

1.4 SUBMITTALS

A. Shop Drawings: For the following:
   1. Manholes: Include plans, elevations, sections, details, and frames and covers.
   2. Catch Basins and Stormwater Inlets: Include plans, elevations, sections, details, and frames, covers, and grates.
   3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, and covers, design calculations, and concrete design-mix report.

B. Quality Assurance/Control Submittals
   1. Product Data: For each material specified herein.
      a. Special pipe fittings.
      b. Backwater valves.
   2. Field Quality Control Test Reports: From Contractor.

1.5 QUALITY ASSURANCE

A. Environmental Agency Compliance: Comply with regulations pertaining to water sanitary sewerage and storm drainage systems.

B. Utility Compliance: Comply with local regulations pertaining to the site work. Include all costs in bid associated with the utilities installation.

C. Unless otherwise instructed, Work is to be observed by the Architect/Engineer; and tests and observation work are to meet his approval at each stage before backfilling. When public authorities require observation and approval by, or supervision of, the Work is required, comply with their requirements. Re-excavate any Work covered before observation and approval at no additional cost to Owner.

D. Install pipe and fittings in strict accordance with best, acceptable practice to insure proper functioning, freedom from trouble, and neatness of appearance.

E. Provide proper fittings for the installation of, and connection to, sewer lines. Where an underground branch connection is required, provide a "Y" branch and 30 degree curve type fitting. Connections made by cutting holes in pipe will not be permitted.

F. Prior to final observation flush sewers with water in sufficient volume to obtain free flow through each line. Remove all obstructions and correct defects discovered.

G. Verify connection requirements with the utility owners.

H. Preinstallation Meeting: Conduct meeting at project site to comply with requirements in Division 01 Section “Project Management and Coordination”. A/E will schedule and conduct meeting.
   1. Before excavation begins, review and coordinate documents with related disciplines, including governmental and utility. Review local, state and federal guidelines and utility requirements. Require representatives, including the following, of each entity directly concerned with utility services, to attend meeting:
      a. Contractor’s superintendent
      b. Local utility representative
      c. A/E’s representative
   2. Send written notification of the meeting to each entity at least 7 day’s in advance stating date, time, and location.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.7 PROJECT CONDITIONS

A. Existing Sewers or Drain Lines
   1. When existing sewers are encountered, whether indicated on the Drawings or not, make adequate provisions for diverting the flow of such existing sewers so that the excavation will be kept dry during the progress of construction. Reroute such existing sewers as required to maintain proper functioning. Before completion of the construction work, restore the existing sewers as called for on the Drawings, or otherwise provide with an adequate outlet, as directed by the Architect/Engineer. Under no conditions abandon or plug an underground line until sufficient tests have been made to indicate that it is not a functioning line, and then only when so directed by the Architect/Engineer in writing.
   2. Reconnect existing drain lines which are to remain in service and which would otherwise be cut off and blocked by new Work.
   3. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to the following requirements:
      a. Notify Owner no fewer than two days in advance of proposed interruption of service.
      b. Do not proceed with interruption of service without Owner’s written permission.

B. Public Rights-Of-Way: Construct sewers to be installed in public rights-of-way, including rights-of-way that are to be dedicated to public use, in strict accordance with standards and methods established by the public authority having jurisdiction over same, and requirements of their specifications shall be complied with. Install other Work occurring on the Owner's property or adjacent property within contract limits in accordance with the requirements of this Section.

C. Relationship to Water Lines
   1. Sewer lines that cross over or under water lines and do not have an 18-inch vertical separation between pipes, must be water grade ductile iron with mechanical joints. The ductile pipe shall comply with ANSI/AWWA C104/A21.4, joints to comply with ANSI/AWWA C111/A21.11. Pipe and fittings to be Class 51. This material is to extend 10 feet on each side of the water line.
   2. Where it is necessary to lay sewer pipes adjacent to existing water lines, where the flow line of the sewer pipe is above or level with the water lines, and the distance between them is less than 10 feet, construct the sewer line of extra heavy cast iron, water seal and test, and relocate the water line, as directed by the Architect/Engineer.
   3. Sewer lines are to have the right-of-way over underground water lines.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Storm Sewer Pipe and Tubing
   1. Supply piping and fittings as required to complete the Work.
   2. Where indicated, piping shall be ductile-iron, Schedule 150, with ductile-iron mechanical joints. Pipe and fittings shall be according to ANSI/ASTM C151/A21.51.
   3. Provide reinforced concrete pipe (RCP) conforming to latest ASTM C76 Class III specifications with rubber gaskets (ASTM C443) for pipe sizes 12 inch diameter and larger.
   4. Provide polyvinylchloride (PVC) pipe, SDR 35 (ASTM D3034), for pipe sizes smaller than 12 inch diameter.
   5. Bushings, reducers, and couplings shall be PVC conforming to requirements of ASTM C-594-70.
   6. Where indicated, provide corrugated metal pipe culvert, helically corrugated 14 gauge steel, with aluminized Type 2 coating. Conform to AASHTO Spec. M-274-791. Corrugations shall be 2-2/3 by 1/2 inch. Provide prefabricated metal end sections for both, corrugated metal and reinforced concrete pipe.
   7. Where “HDPE” is indicated, provide pipe meeting AASHTO M252 Type S or AASHTO M294 Type S High density polyethylene pipe.

8. Underdrains in gravel areas, playground "soft-surface areas," and berm drains shall be perforated, filter wrapped plastic tubing, 4 to 6 inches in diameter. Berm drains shall be 6-inch diameter.
9. Fittings shall be supplied as required to complete the Work. Fittings produced by manufacturers other than the supplier of the pipe shall not be permitted.
10. Provide a manufacturers certification for all storm sewer piping prior to any storm sewer trench excavation.
11. Exposed piping from downspout shall be hub type cast iron.

B. Concrete Structures
1. Manholes and catch basins may be constructed with components of precast concrete.

C. Drainage Castings
1. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion, or other defects. Castings shall be smooth and well cleaned by shot blasting and shall be coated with coal tar epoxy (SSPC Paint 16).
2. Castings shall be equal to those as manufactured by Neenah Foundry Company, Neenah, Wisconsin; East Jordon Iron Works, East Jordan, Michigan; or Zurn, Sanford, North Carolina.
3. Furnish only the following castings for installation under Division 03 Section “Cast-In-Place Concrete”.

D. Water Lead/Main Pipingedit
1. Piping 3 inches or larger shall be Ductile Iron with cement mortar lining complying with ANSI/AWWA C104/A21.4. Fittings shall be ductile iron mechanical joint or push-on type according to ANSI/AWWA C111/A21.11. Fittings shall be Class 51. Provide 8-mil polyethylene tube encasement around pipe per ANSI/AWWA – C105/A21.5
2. Piping 2 inches or smaller shall be Type K copper according to ASTM B88-96. Cast fittings shall meet the requirements of ASTM B61 or ASTM B62.
3. The fire protection lines are to be tested to 200 psi and meet all current NFPA requirements.
4. Install water as per NFPA requirements.

E. Natural Gas LP Piping
1. Shall be plastic piping SDR-11 with stab or fusion joints as approved by the local gas company. Provide #14 coated wire continuous end to end.
2. Valves 2 inch NPS and smaller shall be all brass screwed gas service stops. Gas stops shall be square head type. Valves 2 inch NPS and larger shall be semi-steel, straightway flanged, 125 lbs. SWP, wrench operated, lubricated plug valves. Furnish for each size of plug valve two standard plug valve wrenches. Plug valves shall be fully lubricated before final inspection of Work.
3. Tape to be installed 12 inches above plastic gas line. Tape to read ‘Natural Gas-5 PSI
4. Install gas as per NFPA 54 and local gas company requirements.

F. Sanitary Sewer Piping
1. Shall be SDR-35 PVC piping per ASTM #D-3034.

G. Riprap: Sound and durable rock shall be free of soil and placed as a rock fill for the protection of slopes so denoted on the Drawings. Thin, slablike pieces shall not be used. Rock shall consist of sizes such that the amount of material passing a 3 inch sieve shall not be more than 15 percent by weight of the total material, and the amount of material passing a 6 inch square opening shall not be more than 50 percent by weight of the total material.

2.2 STORM DRAINAGE STRUCTURES

A. Unless otherwise approved by the Architect/Engineer or called for on the Drawings, structures shall be precast concrete made up of vertical sections of appropriate length and diameter to meet drawing requirements. The precast sections shall be reinforced with steel, in accordance with ASTM C478 standards, with tongue and groove joints.

B. The top section shall be flat or tapered to the size required to make a proper base for the cover and frame called for (see plan for type required). The bottom section shall have openings cast therein to receive sewer lines that are to be connected thereto. In the event that a sewer line empties into the manhole at an elevation above the first section, it shall have an opening cast therein to receive such lines.

C. The manufacturer shall cast openings in the sections of the manholes to receive standard rungs of proper design to permit access to the structure without the use of a ladder. Openings for these rungs shall be located in such a way that they will permit the installation of the rungs in a straight, vertical line. The manufacturer shall furnish shop drawings showing the location and size of openings to receive sewer lines, the location of the holes for the access rungs in relation to the openings, the height of the special section, if and when required, to achieve the necessary elevation for the manhole cover and frame, and the contour of the tapered section required to fit the frame called for.

D. All structures shall be provided with size and shape to receive all pipe shown on the Drawings and maintain structure integrity.

E. All pipe connections to the structure shall be ground both inside and outside of the structure.

PART 3 - EXECUTION

3.1 FIELD VERIFICATION

A. The term field verify or similar as related to the utilities shall be defined as a complete exposure of the pipe, manhole or other utility related item. Take field survey measurements to determine the top and invert elevations. Determine the existing material type and/or all other related field features.

B. The Contractor shall locate and expose the existing utility line prior to commencing the general trench excavation for the installation of the new utility lines.

C. The Contractor shall report to the Architect and Construction Manager the existing depth, size, material type, and invert elevation of the utility line.

D. The information determined in the field shall be coordinated with the new utility lines prior to commencing with the general trench excavation.

E. The Architect shall use the additional information obtained in the field and verify the compatibility of the existing utility with the new utility.

F. In the event the existing utility is compatible with the new utility no adjustments to the Drawing will be made.

G. In the event the existing utility is not compatible with the new utility, adjustments to the Drawing or contract will be made in accordance with the General Conditions.

3.2 LAYOUT

A. The Work under this Section shall include the making of a complete layout on the site of storm sewer lines indicating the location of sewer structures, in accordance with the design drawings. Carefully check this layout against the finished grades and other improvements called for on the Drawings. Call conflict or deviation from drawing requirements to the Architect's attention for instructions before proceeding with the Work. Perform layout in cooperation with other Contractors in establishing the exact routing, crossings, and points of connection with the Work of other Contractors.

B. Verify the location, as close as possible, of existing and new utilities prior to excavation. Exercise the utmost care to avoid contact and injury to electrical underground cables and underground utilities. Proper protection of said services must be maintained.

C. Sizes indicated on accompanying Drawings and as specified refer to nominal inside diameter of the pipe, unless otherwise indicated.

3.3 GENERAL PIPE AND STRUCTURE INSTALLATION

A. Excavating, trenching, backfilling, grading, and related work shall follow the Specifications as outlined in Division 31 Section “Earth Moving” and as hereinafter noted.

B. Exercise care in trenching, preparation of the bedding, and installation of the piping materials so that the pipe will be held in a straight line, conforming to the gradients called for on the Drawings.

C. Make sure pipe is properly mated and sealed as it is installed.

D. Maintain a dry trench to avoid sediment entry into the system and to achieve a firm and secure bed. Protect joint work as the Work progresses. When required, perform piping and bailing to meet this requirement.

E. Place a properly designed stopper in the open end of each pipeline when work is not in progress. Where "Y" branches are installed, locate as close as possible to the points shown on the Drawings. Place secure, temporary caps or plugs in branch openings, pending the installation of branch sewers.

F. Where dissimilar pipe is to be connected, install PVC bushings, reducers, or couplings and secure in place with stainless steel bands. Perform installation in accordance with manufacturer's instructions.

G. Exercise care in placing sections of the manhole so as to achieve proper alignment of the holes prepared to receive the manhole rungs.

H. After the manhole has been properly constructed, grout the rungs into the openings provided, so as to achieve a permanent and substantial attachment to the manhole.

I. Make sure that the ends of sewer lines and fittings, which connect into sewer structures, are properly positioned and held in position at the proper elevation and location, so the connections may be constructed as called for on Drawings or in accordance with best trade practice.

J. Where pipe is introduced into manholes or sewer structures after it has been constructed, use methods and take all precautions necessary to insure a watertight, permanent connection. Use a hot poured bituminous compound at such points of connection.

K. Sewer pipe terminating in manholes or sewer structures, installed before such structure is built, shall be completely coated with a uniform layer of hot mix bituminous compound just prior to the construction of the structure and its base, so that a watertight connection will be achieved.

L. Wherever sanitary manholes have inlets with the invert 2 feet or more above the flow line of the outlet base of effluent invert, provide a drop pipe and fittings from the top flow grade to empty onto the floor of the manhole. Encase the drop pipe and fittings in concrete, bonded to the exterior of the manhole and extending from the manhole base, so as to completely encase the drop line and fittings. Provide necessary opening at the bottom of the manhole to permit the incoming water to flow to the outlet. Provide a flow channel from the opening in the manhole connected to the outlet channel. Provide additional width of concrete base to support the drop pipe and enclose.

M. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.

N. Verify the location of existing and new utilities prior to excavation. Exercise the utmost care to avoid contact or injury to electrical underground cables and underground utilities. Proper protection of said services must be maintained.

O. When tying in new sewer lines which are required to take the place of existing sewer lines, maintain service and make the new tie-in in such a way that there will be no interruption of service through existing sewage lines.

P. When existing sewers are encountered, whether indicated on the Drawings or not, make adequate provisions for diverting the flow of such existing sewers so that the excavation will be kept dry during the progress of construction. Reroute such existing sewers as required to maintain proper functioning. Before completion of the construction work, restore the existing sewers as called for on the Drawings or otherwise provide with an adequate outlet, as directed by the Architect. Under no conditions abandon or plug an underground line before making sufficient tests to indicate that it is not a functioning line, and then only when directed by the Architect/Engineer in writing.

Q. Install sewers so that infiltration of ground water in any section of the line will not exceed a rate of 100 gallons per inch of pipe diameter per lineal mile of sewer line in 24 hours. Wherever, in the opinion of the Architect/Engineer, the flow in line or section thereof indicates that such rates of infiltration may be exceeded, furnish the necessary equipment and conduct a test by a method acceptable to the Architect/Engineer to prove that the requirements of this subsection have been complied with. Conduct such test in the presence of the Architect/Engineer or his representative. In the event that the test reveals that the infiltration limit specified herein has been exceeded, make such repairs as are necessary to bring the sewer line up to the specification requirements.

R. When the storm sewer system is complete, and except at the building connection where care must be exercised to achieve a uniform grade and straight alignment, make a light test by flashing a light from manhole to manhole or from the manhole to the cleanout connection. Where a cleanout connection is used, use an appropriate mirror for this test. If the view through the pipe does not show a vertical axis on full pipe diameter and a horizontal axis on at least 3/4 of the pipe diameter, remove and relay the pipe as necessary to meet these requirements. Conduct the light test in the presence of the Architect/Engineer or his representative.
   1. The light test is the responsibility of the Contractor including all items required and scheduling the test.

S. The Contractor under the supervision of the governing agency shall test all PVC and other flexible pipe used for sanitary sewers for deflection. Tests shall not be conducted until at least 60 days after final full backfill has been placed. Maximum allowable deflection shall be 5%. If test is to be accomplished by pulling a mandrel through the pipe, no mechanical equipment shall be used to assist. Sewers that fail this test shall be relayed and re-tested to meet this requirement.

T. All sanitary sewer manholes shall be vacuum tested using the following procedures from ASTM C-1244: All lift holes shall be plugged. All pipes entering the manhole shall be temporarily plugged taking care to securely brace the pipes and plugs to prevent them being drawn into the manhole. The testing equipment shall be placed in the casting to allow the joint between the casting and manhole to be tested. A vacuum of 10” of mercury shall be drawn on the manhole. The valve on the vacuum line of the test head closed and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9” of mercury. The manhole shall pass the test if the time for the vacuum reading to drop from 10” of mercury to 9” of mercury is greater than one minute. If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall be re-tested until a satisfactory test is obtained.

3.4 REINFORCED CONCRETE PIPE INSTALLATION

A. Buried concrete pipe shall rest on a firm bearing, undisturbed earth surface along the entire length of the pipe. Bell or grooved ends shall lay upgrade in a hollowed out bed.

B. Follow manufacturer's recommendations in joining sections of pipe and fittings. Concrete pipe joints shall be sealed with flexible watertight rubber gaskets conforming to ASTM C443 standards.

C. Make line or grade changes and junction with a proper fitting.

3.5 PVC PIPE INSTALLATION

A. Buried PVC pipe shall rest on a firm bearing, bedding material along the entire length of the pipe. Bell or grooved ends shall lay upgrade in a hollowed out bed.

B. Follow manufacturer's recommendations in joining sections of pipe and fittings. PVC joints shall be sealed with flexible, watertight rubber gaskets conforming to ASTM C3212 standards.

C. Line or grade changes and junction shall be made with a proper fitting.

D. Contractor must strictly adhere to Uni-Bell UNI-B-5, recommended practice, except that natural compaction is not allowed for the installation of polyvinyl chloride (PVC) pipe. (Water main and force main piping)

3.6 PERFORATED UNDERDRAIN TUBING AND FRENCH DRAIN INSTALLATION

A. Install drainage pipe pitched down in direction of flow, at a minimum slope of 0.5 percent, unless otherwise indicated.

B. Provide ell's at 90-degree turns, adapters, tees, and transitions as noted or required. Cap laterals at open-end terminals.

3.7 HIGH DENSITY POLYETHYLENE PIPE INSTALLATION

A. Install high-density polyethylene pipe in strict accordance with manufacturer's recommendations.

3.8 INLET INSTALLATION

A. The concrete base shall not be less than 4 inches thick, reinforced. The base shall sit on a minimum 1-1/2 inch thick sand cushion placed over an undisturbed or thoroughly compacted earth excavation. Carefully establish the entire height of the unit so as to meet the top elevation of the inlet lid and as denoted on the Drawings.

B. Set the inlet level to meet elevations as denoted on the Drawings.

3.9 CATCH BASIN INSTALLATION

A. The concrete base shall not be less than 6 inches thick, reinforced as denoted, and shall extend a minimum of 4 inches beyond the exterior wall of the barrel. The base shall sit on a minimum 1-1/2 inch thick sand cushion placed over an undisturbed or thoroughly compacted earth excavation. Carefully establish the entire height of the unit so as to meet the top elevation of the catch basin lid and as denoted on the Drawings.

B. Set the barrel section on the base with a heavy consistency of approved bituminous material so as to provide watertight connections.

C. Grout the top section cover pad to sit level and to meet grade elevations as denoted on the Drawings.

3.10 MANHOLE/MANHOLE - INLET INSTALLATION

A. Verify the location of utilities prior to excavation. After properly preparing the excavation, cast the concrete base for each manhole or structure in accordance with the following:

1. The concrete used shall be of 2500-pound strength as specified in Division 3, Concrete Work. It shall be reinforced with welded wire road mesh not less than 6 by 6-6/6. The concrete base shall be not less than 6 inches thick and extend a minimum of 4 inches beyond the exterior walls of the structure. The height of the base thus prepared shall be carefully established so as to meet the invert elevation requirements of the manholes.
2. After the base has sufficiently set, place the first section of the manhole with the grooved side up. Coat the inside of the manhole for a distance of approximately 6 inches above the base with a heavy consistency of approved bituminous material, so as to provide a watertight connection between the precast manhole and the sewer floor.
3. After the first section has been properly placed and oriented, pour the floor of the manhole, using concrete similar to the quality called for above. The manhole floor shall be not less than 4 inches thick or greater, if the size of the sewers entering same so requires, in order to permit formation of the flow channels hereinafter specified, and so as to maintain not less than 2 inches of concrete below the bottom of flow channels. Form flow channels in the floor of the manhole and locate so as to conform to the sewer lines entering and leaving same. Smoothly finish such flow channels and provide semi-circular section, conforming to the inside diameter of the connecting sewers. The depth of such flow channels shall be approximately 75 percent of the inside diameter of the sewers they connect. Make changes in size or grade gradually. Where changes of direction are required, work them out to form true curves. Provide such channels for connection sewers in each manhole.
4. Continue setting the subsequent sections, using a heavy consistency of asphalt cement at each joint. The channel or groove in the bottom section is to be completely filled with this cement and the tongue of the section above is to be placed in such a way that a watertight connection will be achieved.
5. As the top section of the structure is prepared for setting, carefully check the top elevation and if it fails to conform to the required elevation, it is to be adjusted as may be necessary and approved by the Architect/Engineer so that the finished grade of the manhole frame and cover will occur at the correct elevation, as called for on the Drawings, and to meet job requirements.

3.11 DRAINAGE CASTINGS INSTALLATION

A. After concrete subbase is prepared, accurately set castings in position with top surfaces, coinciding with proposed elevations of concrete slabs and connect as required to storm sewer.

B. Backfill around castings to previous elevation of prepared subbase and compact to same density of remaining prepared subbase.

3.12 RIPRAP INSTALLATION

A. The Contractor is responsible for the procurement and placement of riprap where and as so denoted on the Drawings.

B. Riprap shall be placed on an approved filter cloth as specified in Division 31 Section “Earth Moving”.

C. Riprap placement shall not damage the filter cloth.

3.13 DOMESTIC WATER MAIN

A. All water mains shall be pressure tested and disinfected in accordance with ANSI/AWWA C600-93 and C651-92 standards and local jurisdictions requirements for cleaning, testing, and disinfecting of the water main piping.

B. Install ductile iron piping in a manner similar to that of cast iron soil pipe, except that joints as fittings shall be mechanical joints, with installation as recommended by the manufacturer.

C. Defections from a straight line or grade, as required by vertical or horizontal curves or offsets, shall not exceed 6/D inches per foot of pipe where "D" represents the nominal pipe diameter expressed in inches with deflections measured between the extended center lines of any two connecting lengths of pipe. For alignment in excess of above, shorter lengths or fittings shall be employed.

D. Firmly anchor fittings at bends with concrete thrust blocks and suitably rod to adjacent connecting lines to prevent fittings from being blown off the lines when under service. Provide anchors and yokes at fittings exceeding a turn equivalent to a 1/16 bend.

E. Clamps shall be of the type approved by the National Board of Fire Underwriters. Clamps, rods, washers, and nuts shall be coated with bitumastic coating.

F. Coat exposed threads after nuts are tightened. Tighten bolts to a torque range as follows: 5/8-inch bolt, 40-60 ft.lbs. with 8 inch wrench; 3/4 inch bolt, 60-90 ft.lbs. with 10- inch wrench; 1 inch bolt, 70-100 ft.lbs. with 12 inch wrench, and 1-1/4 inch bolt, 90-120 ft.lbs. with 14 inch wrench. Tighten in a manner so that the gland is brought up toward the pipe flange evenly.

G. Where water mains cross sewers, install the water main above the sewer whenever possible. Provide one full length of water main centered over the sewer so that both joints will be as far from the sewer as possible. Lay water mains with a cover of not less than 5'-0" from top of pipe to finish grade.

H. Use a permanently pliable waterproof material. Special wall sleeve fittings with soft rubber seals are approved. Provide a swing joint on water lines just outside the building to compensate for pipe movement. Anchor lines entering the building to keep fittings from sliding off.

I. Follow piping installation procedures as outlined by the piping manufacturer shall be followed. The Contractor shall be responsible for one year of tightness of joints made by him.

3.14 GAS PIPING

A. Weld piping in accordance with NFPA #54 requirements.

B. Piping system for gas shall be electrically continuous and properly bonded to an approved grounding electrode in accordance with the National Electrical Code, NFPA No. 70.

C. Purge gas lines to the outside atmosphere before putting into service. Purging must be witnessed by the Architect or an authorized person to witness the purging of the lines.

D. Test gas piping systems at <u>not less</u> than 100 psig, for not less than 24 hours. Connect a large dial pressure gauge, with .1# graduations, to the system during testing. Piping systems or portions thereof showing signs of a pressure drop or joint leakage will not be acceptable. In addition, make a final check of flow through the gas meter with outlets closed tight. Visible or evident flow through the meter will require a thorough recheck and retest of the complete system.
   1. Tests must be witnessed and approved.
   2. Whenever leakage exists, Contractor shall properly purge the complete system, repair leaks, and retest.

END OF SECTION 33 05 10