



Project Manual for the Construction of:

GREAT COUNCIL OBSERVATION TOWER

Greene County, Ohio

DNR-250004

September 4, 2025



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State of Ohio Standard Requirements for Public Facility Construction

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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:

DNR-250004
Great Council State Park Observation Tower
Ohio Department of Natural Resources
Xenia, Ohio 45385
Greene County

in accordance with the Contract Documents prepared by:

Schooley Caldwell Associates
300 Marconi Blvd., Suite 100, Columbus, OH 43215
Phone: 614-628-0300
Fax: 614-628-0311
Tyler Young, Project Architect
tyoung@schooleycaldwell.com
www.schooleycaldwell.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.

For more information about EDGE certification, contact the State of Ohio, Department of Development, Minority Business Division at www.minority.ohio.gov or email certifications@development.ohio.gov.

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:

<u>Trade</u>	<u>Estimate</u>
General Contract	\$4,215,000

until **October 1, 2025**, at **2:00pm**, 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 **September 17, 2025 at 9:00am** until approximately **11:00am** at the following location: **Great Council State Park, 1587 US Route 68 North, Xenia, Ohio 45385**.

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

Document 00 21 13 - Instructions to Bidders (General Contracting / Electronic Bid)

State of Ohio Standard Requirements for Public Facility Construction

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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 State's Electronic Bidding Software, facsimile or 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 Certificate of Compliance with Affirmative Action Programs, issued pursuant to ORC Section 9.47, by the Equal Opportunity Coordinator of the Department of Administrative Services;

2.10.3.4 a complete listing of Affirmative Action and EDGE program violations in the last 5 years;

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

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

2.10.3.7 a complete listing of Drug-Free Workplace Program and Drug-Free Safety Program (“DFSP”) violations in the last 5 years;

2.10.3.8 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.

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

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

2.10.3.11 a description of the EDGE-certified Business Enterprises the Bidder proposes as Subcontractors for this Project by attaching a fully completed **EDGE Affidavit** form for each EDGE-certified Business Enterprise;

2.10.3.12 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;

2.10.3.13 a current Ohio Workers' Compensation Certificate;

2.10.3.14 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;

2.10.3.15 evidence that the Bidder is enrolled in, and in good standing in, a DFSP approved by the Ohio Bureau of Workers' Compensation (“OBWC”); and

2.10.3.16 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-responsive 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 advertise for other Bids. The advertisement shall be for the period, in the form, and in the publications 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 The Bidder may be subject to a Pre-Award Affirmative Action Compliance Review pursuant to OAC Section 123:2-5-01 including a review of the Bidder's employment records and an on-site review.

- .1** The Bidder must submit the information requested no later than 10 days after receipt of the request. Failure to timely respond to this request for records may result in the Bidder being found non-responsive.

3.5.2.3 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 by Certified Mail of the finding and the reasons for the finding.

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; or 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 either:

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.

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 Compliance with Affirmative Action Programs, issued by the Equal Opportunity Coordinator. The form must be submitted through the Ohio Business Gateway: <http://business.ohio.gov/efiling/>.

6.1.5 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.

6.1.6 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.

6.1.7 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.

6.1.8 Evidence that the Bidder is enrolled in, and in good standing in, a DFSP approved by the OBWC.

6.1.9 Required Notice of Unresolved Findings for Recovery.

6.1.9.1 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.

6.1.10 EDGE Program – Supporting Documentation Required.

6.1.10.1 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 Enterprise(s) for the Project by submitting a fully completed EDGE Affidavit for each EDGE-certified Business Enterprise, 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 Enterprise(s) for this Project, or both.

6.1.11 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 Enterprise, 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.

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END OF DOCUMENT

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](https://bidexpress.com)

General Info	Alt Total:	Bid Total:
Deadline 10/1/2025 2:00 PM EDT		
Advertised 9/9/2025; 9/16/2025; 9/23/2025		
Number DNR-250004		
Business Name Ohio Department of Natural Resources		
	Description The project comprises two new structures and the renovation of an existing structure: 1) a new observation tower; 2) a new restroom building; 3) renovation of an existing garage into a maintenance building. The tower will be steel-framed and approximately 48' in height; the restroom building will be CMU bearing wall with spread footings and wood roof framing; the maintenance building will receive new exterior finishes over existing structure. The restroom building provides men's and women's restrooms as well as a single-use enclosed ADA-compliant restrooms for visitors.	

Procurement Documents
DNR-250004 M299-03-Public-Bid-Advertisement.eBid.docx → Public Bid Advertisement
00 10 00 EB-Solicitation_GC.docx → Notice to Bidders
DNR-250004 Great Council Observation Tower Bid Project Manual.pdf → Procurement & Contracting Requirements and Specifications
DNR-250004 Great Council Observation Tower Bid Drawings.pdf → Plans, elevations, sections, details, and schedules
4 Attachments

Contract Times and Addenda								
Contract Times The time for Substantial Completion of all Work is 283 consecutive days from the Notice to Proceed.								
Acknowledgement of receipt of Addenda								
<table><thead><tr><th>Date Addendum #1 Received</th><th>Date Addendum #2 Received</th><th>Date Addendum #3 Received</th><th>Date Addendum #4 Received</th></tr></thead><tbody><tr><td></td><td></td><td></td><td></td></tr></tbody></table>	Date Addendum #1 Received	Date Addendum #2 Received	Date Addendum #3 Received	Date Addendum #4 Received				
Date Addendum #1 Received	Date Addendum #2 Received	Date Addendum #3 Received	Date Addendum #4 Received					

Allowance Instructions
Allowance amounts are fixed and no entry of data is required by the Bidder. Include each and every Allowance amount in the Base Bid. The Bidder's Fee (overhead and profit) and costs for unloading and handling on the Site, labor, installation costs, and other expenses contemplated for the Allowance must be included in the Base Bid and NOT in the Allowance amount.

■ Allowances (General Contract)

Item	Description	Allowance Amount*	Extension
Allowance A-1	GC to carry allowance for local electrical utility's aid-to-construction cost	\$12,000.00	
1 Item		Total:	

■ 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	Provide unit price for removal of existing fill and replacement with controlled fill beyond the base 865 cubic yards specified by coded note 7 on sheet L200			Cubic Yards	
1 Item				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 Allowances and 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
Alternates are not included in bid 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. 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 the 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

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 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.

Gary Kubicki
Project Coordinator
Ohio Facility Construction Commission (OFCC)
30 West Spring Street, 4th Floor
Columbus, OH 43215

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	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 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 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)
3 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:																														
<table border="1"> <tr> <td>Bidder Information</td> <td> </td> </tr> <tr> <td colspan="2"> </td> </tr> <tr> <td colspan="2">Business Name:*</td> </tr> <tr> <td colspan="2"> </td> </tr> <tr> <td colspan="2">Business Mailing Address, City, State, Zip:*</td> </tr> <tr> <td colspan="2"> </td> </tr> <tr> <td>Telephone Number:*</td> <td>Facsimile Number:</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td>Federal Tax ID Number:*</td> <td>State of Incorporation (if applicable):</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td>Contact person for Contract processing:*</td> <td>Date enrolled in an OBWC-approved DFSP (month/date/year):</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td>President or Chief Executive Officer's Name:*</td> <td>President or Chief Executive Officer's Title:*</td> </tr> <tr> <td> </td> <td> </td> </tr> </table>			Bidder Information				Business Name:*				Business Mailing Address, City, State, Zip:*				Telephone Number:*	Facsimile Number:			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 or Chief Executive Officer's Name:*	President or Chief Executive Officer's Title:*		
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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

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 Contracting Authority, and the Contractor in connection with the Project.

Project Number: DNR-250004
Project Name: Great Council Observation Tower
Site Address: 1587 US-68,
Xenia, Ohio 45385
Greene County

Owner: Ohio Department of Natural Resources
Owner's Representative: Mary Lynn Happ
Address: 2045 Morse Rd Service Road,
Columbus, Ohio 43229

Contracting Authority: Ohio Facilities Construction Commission
Project Manager: Matthew Spisak
Address: 30 West Spring Street, 4th Floor
Columbus, Ohio 43215

Contractor: «insert name»
Contractor's Principal Contact: «insert name»
Address: «insert street address»
«insert city, state zip code»

Architect/Engineer ("A/E"): Schooley Caldwell Associates
A/E's Principal Contact: William Keoni Fleming
Address: 300 Marconi Boulevard, Suite 100
Columbus, Ohio 43215

ARTICLE 1 - SCOPE OF WORK; EDGE COMMITMENT

1.1 The Contractor shall perform and provide all of the Work described in the Contract.

1.2 The project delivery method for this Project shall be «insert project delivery method».

Two-Year Colleges may delete Section 1.3 below. Otherwise, enter the percentage.

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 Owner 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»

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 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.

Each duration in the Contract Time column above must be calculated from the anticipated date of the Notice to Proceed for the Work covered by this Agreement to the date that the milestone must be achieved. DO NOT insert durations calculated between interim milestones as this DOES NOT comply with the General Conditions.

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.

Edit the above list as appropriate for the Project.

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 Owner’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 Owner gives the Contractor written notice that such funds are available from the Owner’s funding source.

5.1.3 Subject to **Section 5.1.1**, the Contract shall become binding and effective upon execution by the Contracting Authority, Owner, Contractor, and 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 Owner 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.

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.

*The following Treasurer's Certification is required on all Contracts for Projects by and for Two-Year Colleges.
For all other Contracts, delete the Treasurer's Certification below.*

TREASURER'S CERTIFICATION

This signature certifies the amount required to meet the obligation in the fiscal year in which this Agreement is made has been lawfully appropriated for such purpose and is in the treasury or in process of collection to the credit of an appropriate fund free from any previous encumbrances.

Signature

Printed Name

Chief Financial Officer

Institutions of Higher Education may revise "State of Ohio" to "Owner" in the upper right block below.

If the Project is locally administered, delete the "Owner's Concurrence" signature in the lower left block and the associated rows of the table below.

SIGNATURES

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

«INSERT CONTRACTOR'S NAME»

STATE OF OHIO

_____ <i>Signature</i>	_____ <i>Signature</i>
_____ <i>Printed Name</i>	_____ <i>Printed Name</i>
_____ <i>Title</i>	_____ <i>Title</i>
OWNER'S CONCURRENCE by «insert Owner's name»	OHIO ATTORNEY GENERAL Approval as to Form
_____ <i>Signature</i>	_____ <i>Signature</i>
_____ <i>Printed Name</i>	_____ <i>Printed Name</i>
_____ <i>Title</i>	_____ <i>Title</i>
	_____ <i>Date</i>

If the Contractor is a corporation, partnership, sole proprietorship, or limited liability company, use the table above. If the Contractor is a joint venture or special purpose entity, use the table below. Then delete the unused table and this note.

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

STATE OF OHIO
by «insert Contracting Authority's name»

_____ <i>Signature</i>	_____ <i>Signature</i>
_____ <i>Printed Name</i>	_____ <i>Printed Name</i>
_____ <i>Title</i>	_____ <i>Title</i>
by «insert Joint Venturer/Member's name»	OWNER'S CONCURRENCE by «insert Owner's name»

Signature

Signature

Printed Name

Printed Name

Title

*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:	«insert number»
Project Name:	«insert name»
Site Address:	«insert street address» «insert city, 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:	«insert name»
Public Authority Contact:	«insert name»
Address:	«insert street address» «insert city, state zip code»

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 SignatureBy:

Title:

SURETY:

Surety SignatureBy:

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**

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 INFORMATION:

Surety Signature

Street

By: _____
Attorney-in-Fact

City State Zip

Date

Telephone Number

SURETY AGENT'S INFORMATION:

Agency Name

Street

City State Zip

Telephone Number

END OF DOCUMENT

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 Contractor 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' Warranties, 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

Document 00 72 13 - General Conditions (General Contracting Project)
State of Ohio Standard Requirements for Public Facility Construction

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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).

1.1.3 Affirmative Action.

1.1.3.1 The Contractor and Subcontractors shall comply with the State's Equal Employment Opportunity requirements described under OAC Sections 123:2-3 through 123:2-9 that include, without limitation, the requirements described under this **Section 1.1.3**.

1.1.3.2 The Contractor shall demonstrate its good-faith efforts to comply with the utilization goals currently established for minority and women employees and submit documentation to the EOC.

1.1.3.3 By the tenth day of each month, the Contractor and Subcontractors shall submit to the EOC via the internet a completed Ohio Construction Contract Information Report - Input Form 29 (I-29) for the preceding month. The form shall be submitted through the Ohio Business Gateway: <http://business.ohio.gov/efiling/>.

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, and furnish the certifications required by **Section 6.19.8**. 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 the State’s Web-based Project Management Software

1.7.1 If the Contracting Authority decides, in its sole discretion, to utilize the State’s web-based project management software for the Project, the Contractor shall use such software for all compatible services required under this Contract.

1.7.2 All costs for the Contractor’s use of the State’s web-based project management software for the Project shall be included in the Contract Sum. If the Contractor is unfamiliar with the proper use of such 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 EOC.

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 OAC Section 123:2-16-15.

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 EOC 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 may request a Modification by giving written notice under **Section 7.3.2**.

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 of Am. Sub. H.B. 251 of the 126th General Assembly and the resulting 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: <http://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 the State’s web-based project management software, the Contractor shall utilize the web-based forms and reports within the applicable business process. The State’s web-based project management software is sponsored by the Commission, and such 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 must send a response in writing to the Contracting Authority within 30 days of 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 must 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 shall 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.

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.

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 a complete copy of the executed Subcontract between the Contractor and Subcontractor.

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.

4.2.2 No less than ten days before Work is to be performed by a 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.

4.3 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 the Contractor's Subcontractors.

4.4.1.2 The Contractor shall require that each of its Subcontractors 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 Section 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 Partnering

5.1.1 The formation of a cohesive, mutually beneficial partnering arrangement among the Contractor, Contracting Authority, A/E, and Owner will accomplish the construction of the Project most effectively and efficiently. This arrangement draws on their collective strengths, skills, and knowledge to achieve a Project of the intended quality, within budget, and on schedule. To achieve that objective, participation in a partnering session is required for the following key stakeholders:

5.1.1.1 Contracting Authority: Project Manager

5.1.1.2 Owner: Primary representative

5.1.1.3 A/E: Principal-in-charge, project manager, field representative, major consultants

5.1.1.4 Contractor: Principal-in-charge, project manager, and superintendent

5.1.1.5 Major Subcontractors (e.g., plumbing, HVAC, electrical): Principal-in-charge, project manager or superintendent

5.1.1.6 CxA, if applicable

5.1.2 The purpose of the partnering arrangement is to build cooperative relationships between the Project's key stakeholders, avoid or minimize disputes, and nurture a more collaborative ethic characterized by trust, cooperation and teamwork. This arrangement is intended to produce a voluntary, non-binding, but formally structured agreement among the Project's key stakeholders, leading to an attitude that fosters risk sharing.

5.1.3 To create and implement the partnering arrangement, the Project's key stakeholders shall meet prior to the construction of the Project for developing a partnering agreement. The agreement should be comprehensive and focus on all issues necessary for successful completion of the Project, and shall identify common goals and objectives, develop a problem solution process, an Alternative Dispute Resolution ("ADR") strategy in accordance with **Section 8.13**, and an implementation plan for the partnering arrangement.

5.1.4 Formal contractual relations, responsibilities, and liabilities are not affected by any partnering arrangement. The cost associated with establishing this partnership, including but not limited to engaging the services of a Neutral Facilitator, shall be included in an allowance in the Contractor's bid. The Contractor shall include in its base bid the resources necessary to participate in the partnering session.

5.1.5 Partnering services may extend over the entire period of performance of the Contract and may include intervention or project realignment services to be utilized if serious disputes arise. The Project's key stakeholders should agree, during the initial partnering session, to the types of situations and circumstances in which intervention or realignment services shall be utilized.

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.

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-permittee” 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 Unless the Contracting Authority agrees otherwise in writing, the Construction Stage will commence with the Contracting Authority’s issuance of the Notice to Proceed and will terminate upon Contract Completion.

6.2 Responsibility of the Contractor

6.2.1 The Contractor shall complete portions of the Work in the sequence and time in the Construction Progress Schedule.

6.2.2 The Contractor shall supervise the Work.

6.2.3 The Contractor must 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 must cooperate and coordinate fully with all Separate Consultants and Separate Contractors and must 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.

6.2.4 The Contractor must 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.

6.2.5 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.

6.2.6 The intent of **Sections 6.2.3 through 6.2.5** 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.

6.2.7 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 must 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.

6.2.8 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.

6.2.9 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.

6.2.10 The Construction Progress Schedule shall not exceed the time limits current under the Contract Documents, shall provide for reasonable, efficient, and economical execution of the Project, and shall relate to the entire Project to the extent required by the Contract Documents.

6.2.11 The Contractor shall use the Construction Progress Schedule to plan, organize, and execute the Project, record and report actual performance and progress, and show how it plans to coordinate and complete all remaining work by Contract Completion.

6.2.12 The Contractor shall monitor the progress of the Work for conformance with the Construction Progress Schedule and shall initiate revisions as required by **Section 6.5.14**.

6.2.13 The Contractor shall establish the Project's regular working hours, subject to approval by the A/E and the Owner.

6.2.14 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.

6.2.15 In the event of default of the Contractor, the Contractor shall cooperate with the A/E, Contracting Authority, and Contractor's Surety to achieve the Substantial Completion date and Contract Completion.

6.2.16 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.

6.2.17 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 The Contractor shall submit an outline of the qualifications and experience of the Contractor's proposed project manager and proposed superintendent, including references, to the Contracting Authority no less than ten days of the Notice to Proceed. For all Subcontracts in excess of \$200,000, and for all other Subcontracts on request from the Contracting Authority, the Contractor shall submit an outline of the qualifications and experience of the Subcontractor's proposed project manager and proposed superintendent, including references, to the Contracting Authority no less than ten days before the Subcontractor is scheduled to begin Work on the Site.

6.4.3.1 The Contracting Authority may reject the Contractor 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 6.11.2** or any other provision relative to that project manager or superintendent.

6.4.3.2 If the Contracting Authority rejects the Contractor 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 or Subcontractor's (as applicable) proposed replacement project manager or superintendent.

6.5 Construction Progress Schedule

6.5.1 If the Estimated Construction Cost is less than \$500,000, the Contractor may provide a bar chart schedule with a logical sequence of events and sufficient detail to properly anticipate and monitor construction progress. If the Estimated Construction Cost for the Project is \$500,000 or more, the Contractor shall prepare and maintain a resource-loaded Construction Progress Schedule using the critical-path method of scheduling that provides the following information:

6.5.1.1 a graphic presentation of the sequence of the Work for the Project in the media and format required for the Project;

6.5.1.2 identification of each stage of the Work and any Milestone dates;

6.5.1.3 identification of activities and durations for review and approval of Shop Drawings and other action submittals, fabrication and review of mock-up Work, product review and procurement, fabrication, shop inspection, and delivery, including, but not limited to, lead time, coordination drawing delivery, Substantial Completion, Punch List, Punch List Correction, Project close-out requirements, occupancy requirements, and Contract Completion;

6.5.1.4 identification of disruptions and shutdowns due to other operations;

6.5.1.5 identification of the critical path of the Work;

6.5.1.6 identification of the crew size and total resource hours for each activity in the schedule; and

6.5.1.7 the Contractor's signature and date indicating approval.

6.5.2 The Contractor shall develop the Construction Progress Schedule using commercially available, personal computer software acceptable to the Contracting Authority and shall submit all baseline and updated schedules to the A/E in the schedules' native electronic format.

6.5.3 The Construction Progress Schedule shall not exceed the time limits current under the Contract Documents, shall provide for reasonable, efficient, and economical execution of the Project, and shall relate to the entire Project to the extent required by the Contract Documents.

6.5.4 The Contractor shall use the Construction Progress Schedule to plan, organize, and execute the Project, record and report actual performance and progress, and show how it plans to coordinate and complete all remaining Work within applicable Milestones. The Project participants shall use the Construction Progress Schedule as a tool for scheduling and reporting sequenced progress of the Work. The Contractor shall provide a clear graphics legend and other data including, but not limited to, Milestone dates, constraints, and other items required by the Project, A/E, Contracting Authority, and Owner. Each submission shall show the Contracting Authority's Project number and Project name, and provide a signature approval and date line for the Contractor.

6.5.5 The Contractor shall provide in each schedule: Activity identification and description for each activity broken down to a maximum duration that is appropriate for the activity, responsibility of the Contractor, Contractor's resources and crew size for each activity, provide early start, early finish, late start, late finish dates. Each schedule shall show predecessor activities and successor activities for each activity, entry free float, total float, and percentage of completion, and identify the appropriate predecessors and successors for all related activities.

6.5.6 The Construction Progress Schedule shall show all submittal dates, review and approval durations for coordination drawings, Shop Drawings, other action submittals, and mock-up Work.

6.5.7 Within 30 days of the date of the Notice to Proceed, the Contractor shall submit to the A/E a proposed Construction Progress Schedule approved by the Contractor. If the Project is \$4 million total construction cost or more, the Contractor may submit an intermediate Bar Chart Schedule for the first 120 days to the A/E within 30 days of the date of the Notice to Proceed; followed by the complete resource-loaded precedence or arrow diagram schedule within 90 days of the date of the Notice to Proceed.

6.5.7.1 The Contractor shall submit the initial and all updates of the Construction Progress Schedule in graphic and tabular form to the A/E. With each monthly schedule update, the Contractor shall include a list of all changes to the previously approved baseline schedule or monthly updated schedule.

6.5.7.2 After receiving the Construction Progress Schedule, the A/E shall review and submit a copy of the Construction Progress Schedule to the Contracting Authority and Owner for review and acceptance, or reject and return it to the Contractor with recommendations for revisions.

6.5.8 The Construction Progress Schedule shall be managed using early start dates and early finish dates. The Contractor must exhaust existing float before claiming additional time for a Change Order, or show that it is not possible to use float to cover the time requirements of the Change Order.

6.5.9 The Contractor's failure to timely submit and properly maintain an approved Construction Progress Schedule may result in withholding payment in accordance with **Section 9.8**.

6.5.10 For each progress meeting, the Contractor shall provide a two- to six-week look-ahead schedule, as appropriate for the Project.

6.5.11 On a weekly basis, the Contractor shall prepare and submit to the A/E a written report describing:

6.5.11.1 activities begun or finished during the preceding week;

6.5.11.2 activities in progress and expected completion;

6.5.11.3 activities to be started or finished in the upcoming two weeks, including but not limited to, the Contractor's workforce size and total resource hours associated with those activities; and

6.5.11.4 other information requested by the A/E.

6.5.12 The A/E shall attach the above information to the minutes of the weekly progress meetings.

6.5.13 The Contractor shall provide monthly Progress Status Reports to the Contracting Authority, A/E, and Owner, which shall include recommendations for adjusting the Construction Progress Schedule to meet Milestone dates and the Substantial Completion date.

6.5.13.1 If it is apparent to the A/E that the Contractor may be unable to meet critical path activities, Milestone completion dates, or the Substantial Completion date, the A/E shall direct the Contractor to submit within three days a recovery plan to avoid or minimize delay to the Project.

6.5.13.2 A recovery plan shall include, but is not limited to, adjustments to one or more of the following:

- .1** workforce;
- .2** hours per shift;
- .3** shifts per workday;
- .4** workdays per week;

- .5 equipment;
- .6 activity logic.

6.5.13.3 If the A/E approves the recovery plan, the Contractor shall prepare a revised Construction Progress Schedule approved in accordance with **Section 6.5.7**. If the A/E does not approve the recovery plan, the Contractor shall submit within three days an alternate recovery plan to the A/E in writing for review and approval in accordance with **Section 6.5.7**.

6.5.14 The Contractor shall update the Construction Progress Schedule on a monthly basis, or other interval approved by the Contracting Authority, in accordance with **Section 6.5.7**.

6.5.14.1 The updated Construction Progress Schedule approved by the Contractor shall serve as an affirmation that the Contractor can meet the requirements of the updated Construction Progress Schedule.

6.5.14.2 The Contractor shall submit a tabular copy showing all changes to the previously approved schedule including, but not limited to, logic, float, and actual start date of activities. The original or initially approved Construction Progress Schedule and all subsequent Construction Progress Schedules submitted by the Contractor, and accepted by the A/E, shall serve as an affirmation that the Contractor agrees to and can meet the applicable requirements of the updated Construction Progress Schedule.

6.5.14.3 The Contractor's failure to timely submit an approved, updated Construction Progress Schedule may result in withholding payment in accordance with **Section 9.8**.

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 Building Information Modeling ("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 during the coordination meetings.

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 Request for Information ("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 respond to an RFI within three days of receiving the 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 may request a Change Order by giving written notice under **Section 7.3.2** within seven days of receiving the A/E's RFI response.

6.8.4 If the Contractor does not notify the A/E per **Section 6.8.3**, the Contractor will have accepted the RFI response without an adjustment to the Contract Sum or Contract Times.

6.9 Protection of the Project

6.9.1 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.

6.9.1.1 The Contractor shall at all times cover or protect the Work.

6.9.1.2 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.

6.9.1.3 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.

6.9.1.4 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.

6.9.2 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.

6.9.3 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.

6.9.4 The Contractor shall provide all temporary bracing, shoring, and other structural support required for safety and proper execution of the Work.

6.9.5 Vibration, Noise, and Dust Control.

6.9.5.1 The Contractor shall provide controls/barriers for vibrations, noise, and dust control in occupied buildings as required by the construction operations.

6.9.5.2 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.

6.9.5.3 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.

6.9.5.4 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.

6.10 Materials and Equipment

6.10.1 The Contractor shall provide new materials and equipment of the quality specified in the Contract Documents.

6.10.2 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.

6.10.2.1 The Contractor shall properly store and protect all materials and equipment it provides to the Project.

6.10.2.2 The Contractor shall timely remove from the Site any materials or equipment no longer required for the Work.

6.10.3 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.

6.10.4 If the Contractor provides an Acceptable Component, the Contractor shall be solely responsible for the costs of coordination and modification required.

6.10.5 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.

6.10.6 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:

6.10.6.1 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

6.10.6.2 the specified Basis of Design Components, Acceptable Components, or previously-approved Substitutions will not perform as designed or intended.

6.10.7 The Contractor’s incorporation of unapproved Substitutions in the Work is Defective Work.

6.11 Labor

6.11.1 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.

6.11.2 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.

6.11.3 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.

6.12 Safety Precautions

6.12.1 The Contractor shall take reasonable precautions to ensure the safety of individuals on the Project.

6.12.1.1 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).

6.12.2 The Contractor shall pay any fine or cost incurred because of the Contractor’s violation, or alleged violation, of Applicable Law.

6.12.3 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.

6.12.4 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.

6.12.4.1 If the Contractor brings Hazardous Materials to the Project, the Contractor must take reasonable precautions to prevent the Hazardous Materials from causing bodily injury or death, property damage, or environmental damage.

6.12.4.2 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.

6.12.4.3 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.

6.12.5 Work Stoppage Due to Hazardous Materials.

6.12.5.1 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.

6.12.5.2 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.

6.12.5.3 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.

6.12.5.4 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.

6.12.5.5 The term "rendered harmless" means that the level of exposure is less than any applicable exposure standards set forth in Applicable Law.

6.12.6 Safety Data Sheets.

6.12.6.1 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.

6.12.6.2 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.

6.13 Construction Facilities, Utilities, and Equipment

6.13.1 Facilities.

6.13.1.1 The Contractor shall provide and maintain clean and suitable temporary facilities, equipment, services, and enclosed storage for its use at the Site.

6.13.1.2 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, and furnishings to conduct progress meetings, and store approved documents and permits; and
- .3 adequate sanitary facilities for use by all Persons at the Site.

6.13.2 Environmental Controls.

6.13.2.1 The Contractor shall protect its Work and materials from weather and damage from heat, cold, and humidity.

6.13.2.2 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.

6.13.2.3 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.

6.13.2.4 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.

6.13.2.5 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.

6.13.3 Water and Drainage.

6.13.3.1 The Contractor shall provide water necessary for the Work until the permanent plumbing system is available for use.

6.13.3.2 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.

6.13.3.3 The Contractor shall make arrangements and pay for installation and maintenance of temporary plumbing systems until the permanent plumbing system is available for use.

6.13.3.4 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.

6.13.3.5 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.

6.13.3.6 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.

6.13.4 Electric Service.

6.13.4.1 The Contractor shall provide temporary light and power; and pay the charges for temporary electric service installation, and removal if required.

6.13.4.2 If the Project consists entirely of new construction, the Contractor shall pay the cost of energy consumed until Substantial Completion.

6.13.4.3 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.

6.13.4.4 From the date of Substantial Completion, the Owner shall pay the cost of energy consumed for the occupied portions of the Project.

6.13.4.5 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.

6.13.5 Hoisting Facilities.

6.13.5.1 The Contractor shall erect and maintain any hoisting equipment required for its Work.

6.13.5.2 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.

6.13.5.3 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.

6.14 Progress Cleaning

6.14.1 The Contractor shall remove all waste materials, rubbish, and mud attributable to the Work to an appropriate disposal location at, or near, the Site.

6.14.2 The Contractor shall perform weekly broom cleaning of hard flooring surfaces in the area of the Work.

6.14.3 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.

6.14.4 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.

6.14.4.1 The Contractor shall dispose of waste materials, rubbish, and construction debris in a lawful manner in approved recycling facilities or landfills.

6.14.5 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.

6.14.5.1 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.

6.14.6 The Contractor shall remove excavated material and spoil to a suitable off-site location approved by the Contracting Authority.

6.14.6.1 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.

6.15 Use of Premises

6.15.1 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.

6.15.2 Loitering or wandering through the interior of buildings or exterior grounds outside the limits of the Work will not be permitted.

6.15.3 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.

6.15.4 No signs or advertising of any kind will be permitted on or about the Site, except those appearing on trucks and trailers.

6.15.5 Site Logistics Plan.

6.15.5.1 The Contractor shall prepare a plan of the Site indicating how the Contractor intends to use the Site. The plan should illustrate, as an example, 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.

6.15.6 Smoking and Tobacco Products.

6.15.6.1 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.

6.16 Interruption of Existing Services

6.16.1 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.

6.16.2 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.

6.17 Explosives and Blasting

6.17.1 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.

6.17.2 The Contractor shall perform all blasting, storing, and handling of explosives as required under Applicable Law.

6.17.2.1 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.

6.18 Building Commissioning

6.18.1 If the Project scope includes building commissioning, the Contractor shall participate in the Commissioning Process, as prescribed in the Contract Documents.

6.18.2 The Contractor shall permit the A/E, or a third-party Commissioning Agent ("CxA") if applicable, access to commission performance based equipment, fixtures, and/or systems (e.g., HVAC, fire protection, smoke evacuation, fume hoods, emergency power, etc.), prior to Substantial Completion.

6.18.3 The A/E, or CxA if applicable, shall promptly notify the Contractor in writing of any deficiency identified during the Commissioning Process.

6.18.4 To facilitate the Commissioning Process, the Contractor shall submit four sets 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.

6.19 Action Submittals

6.19.1 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:

6.19.1.1 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;

6.19.1.2 capacities, types of materials and performance charts that are pertinent to the materials, and performance charts that are pertinent to the equipment item; and

6.19.1.3 wiring diagrams, control diagrams, schematic diagrams, working and erection dimensions, arrangement and specifications.

6.19.2 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.

6.19.2.1 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 State's web-based project management software.

6.19.2.2 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.

6.19.2.3 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.

6.19.3 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.

6.19.3.1 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.

6.19.3.2 The Contractor shall not be relieved of responsibility for deviations from the Contract Documents by the A/E's approval of submittals.

6.19.3.3 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.

6.19.4 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.

6.19.4.1 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.

6.19.4.2 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.

6.19.4.3 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.

6.19.5 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.

6.19.5.1 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.

6.19.5.2 When resubmitting corrected submittals, the Contractor shall direct the A/E's attention to revisions made by noting revisions on the resubmittal.

6.19.5.3 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.

6.19.5.4 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.

6.19.5.5 If coordinating submittals are not received within the period required for action on previously received submittals that are held in accordance with **Section 6.19.5.4**, review of the previously received submittals may be delayed.

6.19.5.6 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.

6.19.5.7 The review and approval of a separate item shall not indicate approval of the assembly in which the item functions.

6.19.6 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.

6.19.7 Equipment Statement. Shop Drawings on equipment shall include the following written statement from the manufacturer of the equipment:

6.19.7.1 “This equipment submitted for approval shall perform as specified when installed in the arrangement shown on this drawing and in the Contract Documents and in conjunction with all other accessories as flues, breechings, piping, controls, and equipment not furnished by this manufacturer, but required as an accessory or supplement to this equipment, providing that the accessory or supplementary items perform as specified and are installed as shown in the Contract Documents.”

- .1 The Contractor will be deemed to have included the above statement as required even if the associated Shop Drawing does not actually contain the statement.

6.19.7.2 This equipment statement shall not be required for Samples, Product Data, and other standard submittals that are not created specifically for this Project.

6.19.8 Domestic Steel Certifications. The Contractor shall include the following written certifications on the front cover or initial sheet of each structural steel fabrication Shop Drawing, signed and dated prior to fabrication:

6.19.8.1 “Steel Fabricator Certification: The steel fabricator identified below certifies that for this project all load-bearing structural steel has been fabricated or produced, to the best of its knowledge, only from steel made in the United States in accordance with Ohio Revised Code Section 153.011. 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 Ohio Revised Code Section 153.99.” This certification shall be followed by the name of the fabrication company, name of the company official signing the certification, the signature of that company official, and the date of that signature.

- .1 The Contractor will be deemed to have included the above certification as required even if the associated Shop Drawing does not actually contain the certification.

6.19.8.2 “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 shall be fabricated and produced using, to the best of its knowledge, only steel made in the United States in accordance with Ohio Revised Code Section 153.011. Further, the contractor hereby certifies that it has read and understands that a monetary penalty for violations may be imposed under the authority of Ohio Revised Code Section 153.99.” This certification shall be followed by the name of the Contractor company, name of the company official signing the certification, the signature of that company official, and the date of that signature.

- .1 The Contractor will be deemed to have included the above certification as required even if the associated Shop Drawing does not actually contain the certification.

6.20 Warranty

6.20.1 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.

6.20.2 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.

6.21 Additional Tests and Inspections

6.21.1 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.

6.21.1.1 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.

6.21.1.2 The Contracting Authority may deduct the costs described under **Section 6.21.1.1** 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.

6.21.1.3 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 may request a Change Order by giving written notice under **Section 7.3.2** within seven days after the special inspection, testing, or approval.

6.21.2 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.

6.21.3 Except as described under **Section 6.21.1**, the Owner shall pay for any inspection, testing, or approval that did not become a requirement until after it awarded the Contract.

6.21.4 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.

6.21.5 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.

6.22 Uncovering the Work

6.22.1 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.

6.22.2 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.

6.22.2.1 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.

6.22.2.2 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 may request a Change Order by giving written notice under **Section 7.3.2** within seven days after the Contracting Authority or A/E observes the uncovered Work.

6.23 Correction of the Work

6.23.1 Before Substantial Completion.

6.23.1.1 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 no more than three days after the Contracting Authority issues the written notice ("72-Hour Notice").

6.23.1.2 If the Contractor fails to promptly commence and diligently pursue correction of the Defective Work and recovery of schedule deficiencies required under **Section 6.23.1.1**, 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.

6.23.2 After Substantial Completion.

6.23.2.1 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 6.24.1**. 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.

6.23.2.2 During the Correction Period. If the Contracting Authority or Owner issues a notice under **Section 6.23.2.1** 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.

6.23.2.3 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 6.23.2**.

6.23.2.4 After the Correction Period. If the Owner issues notice under **Section 6.23.2.1** 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.

6.23.3 Emergency Correction of Defective Work.

6.23.3.1 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.

6.23.4 Responsibility for Costs of Correction.

6.23.4.1 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 6.23**. 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.

6.24 Acceptance of Defective Work

6.24.1 Before final Contract Completion, the Owner may accept any Defective Work instead of requiring its removal or correction, in which case the Contract Sum must be equitably reduced as described under **Article 7**.

6.24.1.1 The Owner may only accept Defective Work through a deduct Change Order that makes explicit reference to this **Section 6.24**.

6.24.1.2 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.

6.24.2 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:

- 6.24.2.1** observations or inspections by the Owner, Contracting Authority, or A/E;
- 6.24.2.2** the making of any payment;
- 6.24.2.3** Substantial Completion or the issuance of a Certificate of Substantial Completion;
- 6.24.2.4** Partial Occupancy and the Owner's use or occupancy of the Work or any part of it;

- 6.24.2.5 Contract Completion or the issuance of a partial or final Certificate of Contract Completion;
- 6.24.2.6 any review or approval of a submittal;
- 6.24.2.7 any inspection, test, or approval by other Persons; or
- 6.24.2.8 any correction of Defective Work by the Owner.

6.25 Project Document Maintenance and Submittal

6.25.1 During Construction.

6.25.1.1 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 6.2.17**.

6.25.1.2 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.

6.25.1.3 The Contractor shall keep a record of changes made to the Specifications, noting particularly any approved variation from manufacturers' installation instructions and recommendations.

6.25.1.4 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.

6.25.1.5 The Contractor shall at all times permit access to the documents described in this **Section 6.25.1** to authorized representatives of the State, local authorities having jurisdiction, Contracting Authority, Owner, and A/E.

6.25.2 Before Contract Completion.

6.25.2.1 The Contractor, as a condition precedent to execution of the Certificate of Contract Completion and final payment, shall organize the As-Built Documents into manageable sets, bind the sets with durable paper cover sheets, and deliver the As-Built Documents to the A/E.

6.25.2.2 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, organized into suitable sets of manageable size. Indexed data bound in individual binders, with pocket folders for folded sheet information and appropriate identification marked on the front and the spine of each binder;
- .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;
- .8 an affidavit to certify that all Subcontractors have been paid in full for all Work performed or materials furnished for the Project;
- .9 final certified payroll reports; and
- .10 an affidavit to certify that the Contractor and each of its Subcontractors, regardless of tier, have complied with all requirements of ORC Chapter 4115.

6.25.2.3 By submitting the As-Built Documents to the A/E, the Contractor certifies that its As-Built Documents are complete, correct, and accurate.

6.25.3 Record Documents.

6.25.3.1 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.

6.25.3.2 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.

6.26 Final Cleaning

6.26.1 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.

6.26.2 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.

6.26.3 Final cleaning shall be done to the reasonable satisfaction of the A/E and Contracting Authority.

6.27 Substantial Completion**6.27.1 Contractor’s Punch List.**

6.27.1.1 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.

6.27.2 Substantial Completion Inspection.

6.27.2.1 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 9.7.2.**
- .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 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.

6.27.3 Completion of Punch List Items.

6.27.3.1 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 request for the Final Inspection of the Work, 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. 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.

6.28 Partial Occupancy

6.28.1 The Owner may occupy or use a portion of the Project prior to Substantial Completion of all Work if:

6.28.1.1 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;

6.28.1.2 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

6.28.1.3 the Contracting Authority has received notice of the Partial Occupancy from the A/E and has consented to it.

6.28.2 Before the Owner commences Partial Occupancy, the Owner, Contracting Authority, A/E, and Contractor shall proceed as described under **Section 6.27** for the area designated for Partial Occupancy.

6.28.3 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.

6.29 Demonstration and Training, Operating Appurtenances

6.29.1 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.

6.29.2 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:

6.29.2.1 keys to door and window hardware, panels, and other devices not directly provided to the Owner from the manufacturer;

6.29.2.2 operating handles, levers, cranks, specialized wrenches or drivers, remote controls, and similar items; and

6.29.2.3 extra materials (e.g., attic stock).

6.30 Contract Completion**6.30.1 Partial Contract Completion.**

6.30.1.1 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.

6.30.1.2 The A/E shall submit the partial Certificate of Contract Completion to the Contracting Authority, Owner, and Contractor for their written acceptance. Upon their acceptance of the partial Certificate of Contract Completion

and consent of the Contractor's Surety, the Contracting Authority may release payment to the Contractor, as determined in the sole discretion of the Contracting Authority.

6.30.2 Final Contract Completion.

6.30.2.1 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 6.25 through 6.29** have been fulfilled, the A/E shall prepare and recommend execution of a final Certificate of Contract Completion.

6.30.2.2 The date that the Contracting Authority executes the final Certificate of Contract Completion is the date of Contract Completion.

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 7.5**.

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 constitutes a waiver by the Contractor of an 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 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 The A/E shall issue a Change Order to reconcile the difference between the scheduled and actual quantities of Unit Price Work performed and materials furnished.

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 proposed would create an undue hardship on either the Owner or Contractor, the A/E shall issue a Proposal Request and subsequent Change Order to adjust the Unit Price.

- .1** 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.

7.1.5.4 If the actual quantity of a Unit Price item exceeds the scheduled quantity by 20 percent or more, the Contractor shall immediately notify the A/E, who shall issue a Change Directive and subsequent Change Order to authorize an adjustment in the scheduled quantity.

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 Order Procedure

7.2.1 A Change Order is a written instrument prepared by the A/E and executed by the Contracting Authority 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 **Section 7.4.8**, 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 direct and indirect 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 Initiation of Change Orders

7.3.1 Proposal Request.

7.3.1.1 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 the Contract Times, or both, associated with a contemplated Modification.

- .1** In any Proposal for an adjustment of the Contract Sum, the Contractor shall specifically identify the items set forth in **Section 7.7**.
- .2** In any Proposal for an adjustment of the Contract Times, the Contractor shall specifically identify the items set forth in **Section 7.8**.
- .3** The Contractor's cost of preparing and providing Proposals is included in the Contract Sum.

7.3.1.2 The Contractor shall respond with a Proposal to the A/E and Contracting Authority within 14 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.

7.3.1.3 The Contractor shall hold the 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. The time limits described under this **Section 7.3.1.3** apply only to Proposals submitted in response to a Proposal Request.

7.3.1.4 A Proposal may be accepted by the Contracting Authority only through a Change Order. A Proposal Request does not authorize the Contractor to proceed with a change in the Work.

7.3.1.5 If the Contractor does not timely submit a Proposal within the time required in **Section 7.3.1.2**, the Contractor waives its right to an adjustment to the Contract Sum or Contract Times, or both, associated with the contemplated change in the Work.

7.3.2 Request for Change Order.

7.3.2.1 The Contractor may initiate a change in the Work by submitting written notice to the A/E accompanied by a Proposal meeting the requirements of **Section 7.3.1**.

7.4 Change Directives

7.4.1 A Change Directive is a written order prepared by the A/E and executed by the Contracting Authority directing a change in the Work and may, if necessary:

- 7.4.1.1** state a proposed basis for adjustment, if any, in the Contract Sum or Contract Times, or both; or
- 7.4.1.2** 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.

7.4.2 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 7.4.1**, authorizing the Contractor to proceed.

7.4.3 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.

7.4.3.1 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 the situation described under **Section 7.5.3**.

7.4.4 Upon receipt of a Change Directive, the Contractor shall promptly proceed with the change in the Work involved.

7.4.5 The Contractor may sign the Change Directive to accept the proposed basis for adjustment, if any, of the Contract Sum or Contract Times, or both. 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**.

7.4.6 Within 14 days after receiving the Change Directive, the Contractor shall respond with a Proposal meeting the requirements of **Section 7.3.1** to the A/E and Contracting Authority 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 7.4.1.2. If the Change Directive is performed on a time and materials basis, the Contractor shall submit its Proposal within seven days after completing the Work.

7.4.6.1 The Proposal for the adjustment of the Contract Sum, if any, shall include: **(1)** written documentation as described under **Section 7.7**; and **(2)** a written statement from the Contractor that the proposed adjustment is the entire adjustment in the Contract Sum associated with the change.

7.4.6.2 The Proposal for the change in the Contract Times, if any, shall include: **(1)** written documentation as described under **Section 7.8**; and **(2)** a written statement from the Contractor that the proposed adjustment is the entire adjustment of the Contract Times associated with the change.

7.4.7 If the Contractor does not respond to a Change Directive as required under **Section 7.4.5** or **Section 7.4.6**, the Contracting Authority shall determine the adjustments, if any, of the Contract Sum and Contract Times, and the A/E shall prepare a Change Order consistent with that determination. Notwithstanding any other provision of the Contract to the contrary, that Change Order will modify the Contract Documents when it is signed by the Owner and Contracting Authority. If the Contractor does not agree with the Contracting Authority's determination, the Contractor shall initiate a Claim under **Article 8** within ten days after the date that the Contracting Authority issues its determination, and the Contractor's failure to do so shall constitute an irrevocable waiver of the Claim.

7.4.8 Pending final determination of the total adjustment of the Contract Times on account of a Change Directive, the period of time not in dispute for that change in the Work may be included in the Construction Progress Schedule accompanied by a Change Order indicating the parties' agreement with part or all of the time adjustment.

7.4.9 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 within seven days after receiving the Contractor's Proposal. The A/E, Contracting Authority, Owner, and Contractor shall promptly sign the Change Order as described under **Section 7.2**.

7.4.10 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 within 60 days after the Change Directive is issued, the Contracting Authority shall determine the adjustments, if any, of the Contract Sum and Contract Times, and the A/E shall prepare a Change Order consistent with that determination. Notwithstanding any other provision of the Contract to the contrary, that Change Order will modify the Contract Documents when it is signed by the Owner and Contracting Authority. If the Contractor does not agree with the Contracting Authority's determination, the Contractor shall initiate a Claim under **Article 8** within ten days after the date that the Contracting Authority issues its determination, and the Contractor's failure to do so shall constitute an irrevocable waiver of the Claim.

7.5 Minor Changes in the Work

7.5.1 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.

7.5.2 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.

7.5.3 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 three 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.

7.5.4 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:

7.5.4.1 starting the Work that is the subject of the order for a minor change in the Work; or

7.5.4.2 failing to give the notice described under **Section 7.5.3** within three business days after receiving the order for a minor change in the Work.

7.6 Differing Site Conditions

7.6.1 If the Contractor encounters a Differing Site Condition, the Contractor shall stop Work on that Differing Site Condition and give immediate written notice of the condition to the A/E and Contracting Authority.

7.6.1.1 The Contractor's failure to give notice of the Differing Site Condition as required under this **Section 7.6.1** shall constitute an irrevocable waiver of any associated Claim.

7.6.1.2 The written notice of a Differing Site Condition under this **Section 7.6.1** shall be required before the notice of Claim under **Article 8**.

7.6.2 Promptly after receiving notice from the Contractor under **Section 7.6.1**, 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.

7.6.2.1 If the A/E determines that the Contractor has encountered a Differing Site Condition and the Contracting Authority agrees with the A/E's determination, the A/E shall process an appropriate Change Order.

7.6.2.2 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 appropriate Change Directive through which the Contracting Authority may convey its disagreement with the A/E's determination.

7.6.2.3 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 must initiate a Claim under **Article 8** within ten days after the date that the A/E issues its determination.

7.7 Change Order Cost or Credit Determination

7.7.1 General.

7.7.1.1 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 7.7.1.4**.
- .2** A Unit Price Proposal shall only be valid when incorporated into the Contract by Change Order.
- .3** The maximum cost or credit includes all compensation for impact costs. Additional costs for impacts shall not be allowed.

7.7.1.2 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.

7.7.1.3 The Contracting Authority may require notarized invoices for material costs and may audit the records of the Contractor and Subcontractors.

7.7.1.4 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 7.7.2**. Any Subcontractor pricing shall be itemized on the appropriate **Proposal Worksheet Summary Form**.

7.7.1.5 **Section 7.7.2** establishes the exclusive and maximum amount that the Owner shall pay for any Change Order, 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 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 7.7.2**.

7.7.2 Pricing Criteria.

7.7.2.1 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 7.7.2.1** exceed those additional Contractor Personnel Costs the Contractor actually incurs.

7.7.2.2 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 7.7.2.2** 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 7.7.2.1** for the Contractor and under **Section 7.7.2.10** for Subcontractors.

7.7.2.3 Fringes. Fringe benefit credit for labor provided under **Section 7.7.2.2** 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.

7.7.2.4 Allowable Payroll Expenses. Allowable payroll expenses for labor provided under **Section 7.7.2.2** 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.

7.7.2.5 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. Contractor shall submit copies of actual paid invoices to substantiate rental costs.

7.7.2.6 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 Green 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.

7.7.2.7 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.

7.7.2.8 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.

7.7.2.9 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 7.7.2.9.1**, 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 7.7.2.9.1**, and (2) include the actual adjustment of the builder's risk insurance premium attributable to an associated change in the Contract Sum.

7.7.2.10 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 7.7.2.2 through 7.7.2.8** 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 7.7.2.10** 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 7.7.2.10**, (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 7.7.2.11**, 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: 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 other home office expense, legal services, travel, and parking expenses.
- .3 An exception is allowed for shop or engineering labor on items in **Section 7.7.2.10.2**, 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 7.7.2.2, 7.7.2.3, and 7.7.2.4** of these Pricing Criteria.
- .4 An exception is allowed for field supervision labor on items in **Section 7.7.2.10.2**, 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 7.7.2.2, 7.7.2.3, and 7.7.2.4** of these Pricing Criteria.

7.7.2.11 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 7.7.2.1 through 7.7.2.10** that are associated with that changed Work.

7.7.2.12 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 7.7.2.11** or Subcontractor overhead and profit under **Section 7.7.2.10**.

- .1 The premium portion only for approved overtime (labor and fringes). The straight time portion is included in items in **Sections 7.7.2.2, 7.7.2.3, and 7.7.2.4**.
- .2 State sales tax shall be allowed on items as defined by **Section 12.7**.

7.7.3 Costs that shall not be reimbursed for Change Order Work include the following:

7.7.3.1 Voluntary employee deductions including, but not limited to, deductions for charitable donations or U.S. savings bonds.

7.7.3.2 Employee profit sharing.

7.8 Time Extension

7.8.1 Every adjustment of the Contract Times associated with any change in the Work shall be determined as provided in this **Section 7.8**, 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 7.8** also governs time adjustments for deduct Change Orders and the Contractor's entitlement to additional time through the claims and dispute resolution processes on account of changes in the Work.

7.8.2 The Contractor shall substantiate all changes in the Contract Times with:

- 7.8.2.1** a written description of the nature of the interference, disruption, hindrance, or delay;
- 7.8.2.2** identification of Persons and events responsible for the interference, disruption, hindrance, or delay;
- 7.8.2.3** date or anticipated date of commencement of the interference, disruption, hindrance, or delay;

7.8.2.4 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;

7.8.2.5 anticipated duration of the interference, disruption, hindrance, or delay and of any remobilization period;

7.8.2.6 specific number of days of extension requested and specific number of days for remobilization requested;

7.8.2.7 recommended action to avoid or minimize any future interference, disruption, hindrance, or delay; and

7.8.2.8 a detailed written proposal as described under **Section 7.7** 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.

7.8.3 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.

7.8.3.1 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.

7.9 Examination and Audit of Contractor's Records

7.9.1 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.

7.9.2 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 six years after the date of Substantial Completion of all Work.

7.9.2.1 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.

7.9.3 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 law, as trade secrets of the Contractor or Subcontractor, as applicable.

7.9.3.1 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.

7.9.4 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.

7.9.5 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 six years from the date of any applicable final settlement or payment, as applicable.

7.9.6 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, with the following exceptions:

8.1.2.1 The ten-day time limit on initiating a Claim arising from a determination of the Contracting Authority concerning a Change Directive begins to run on the date that the Contracting Authority issues its determination under **Section 7.4.7** or **Section 7.4.10**, as applicable.

8.1.2.2 The ten-day time limit on initiating a Claim arising from the response of the A/E to an RFI begins to run on the date that the A/E issues the A/E's response to the RFI.

8.1.2.3 The ten-day time limit on initiating a Claim arising from the A/E's determination concerning a Differing Site Condition begins to run on the date that the A/E issues the A/E's determination under **Section 7.6**.

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 7.7** 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 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** shall constitute the Contractor's irrevocable waiver of the Claim.

8.1.5 The A/E, in consultation with the Contracting Authority, shall respond to the written notice of the Claim within a reasonable time of receipt, but not to exceed ten days.

8.2 Substantiation of Claims

8.2.1 Within 30 days after the initiation of a Claim, the Contractor shall submit four 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 four copies by delivery of one copy to the A/E, one copy to the Owner, and two copies 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 6.2.17**) 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, 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** shall constitute an irrevocable waiver of any related Claim.

8.3 Substantiation of Claims for 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 7.7** of the actual additional direct and indirect costs to the Contractor due to the event giving rise to the Claim;

8.3.1.2 a written statement from the Contractor that the increase requested is the entire increase in the Contract Sum associated with the Claim; and

8.3.1.3 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** shall constitute an irrevocable waiver of any related Claim.

8.4 Substantiation of Claims for 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 7.8** 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 detailed written Proposal as described under **Section 7.7** 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 8.3.1.2**;

8.4.1.3 a written statement from the Contractor that the extension requested is the entire extension of the Contract Times associated with the Claim; and

8.4.1.4 the general substantiating documentation described under **Section 8.2**.

8.4.2 In addition to the requirements of **Section 8.4.1**, if adverse weather conditions are the basis for a Claim for additional time, the Contractor shall document the Claim with data substantiating that weather conditions were abnormal for the period, could not have been reasonably anticipated, and had an adverse effect on a critical element of the scheduled construction. The support for and evaluation of all adverse weather Claims shall be based upon average weather conditions during the five years immediately preceding the dates at issue in the Claim as those weather conditions were recorded at the government-controlled weather-recording facility nearest to the Site.

8.4.3 The Contractor's failure to comply with the requirements of this **Section 8.4** shall 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** or before Contract Completion, whichever is earlier, 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 for which the Contractor believes the State is liable; 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 for which the Contractor believes the State is liable; 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** shall 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 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 If the Contractor simultaneously fails to achieve two or more Milestones, the Owner shall be entitled to recover the sum of the associated Liquidated Damages per day rates.

8.7.3 The Liquidated Damages described in this **Section 8.7** are only intended to compensate the Owner for the direct damages it incurs as a result of the Contractor's failure to achieve the Milestones within their associated Contract Times.

8.7.4 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 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.

8.7.5 The parties acknowledge that the above-listed Liquidated Damages per day sums are not penalties, and they 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.

8.7.6 In addition to other rights that the Owner may have relative to the Liquidated Damages, the Contracting Authority may deduct the 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 7.7**; 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 affected 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 shall 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 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 All Allowances include the cost to the Contractor (less any applicable trade discounts) of materials and equipment required by the Allowances to be delivered at the Site, and all applicable taxes.

9.1.3 The Contractor's Fee and costs for unloading and handling on the Site, labor, installation costs, and other expenses contemplated for the Allowances are not in the stated Allowance amounts but are otherwise included in the Contract Sum.

9.1.4 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 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 on that Unit Price Work.

9.2.2 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.

9.2.3 The Contractor's Fee on account of Unit Price Work is not in the stated Unit Price amounts but are otherwise included in the Contract Sum.

9.2.4 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.

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 (overhead and profit), for each EDGE-certified Business used in the performance of the Work. The amount(s) shall indicate labor and materials, as appropriate.

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. Separate items shall not be shown for Contractor's Fee, except when Work is performed or materials are supplied by an EDGE-certified Business, pursuant to **Section 9.3.1.1**. Contractor's Fee shall be included in the totals for labor and materials.

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 The Contractor may submit a Contractor Payment Request for Work performed based upon the Schedule of Values 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.

9.4.1.1 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.

9.4.1.2 The Contracting Authority may require proof of the renewal of required insurance as a condition precedent to payment.

9.4.1.3 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**.

9.4.1.4 The Contractor may list on the Contractor Payment Request any Change Orders approved and performed prior to submission of the Contractor Payment Request.

9.4.1.5 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.

9.4.1.6 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.

9.4.1.7 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.

9.4.1.8 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.

9.4.2 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.

9.4.3 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.

9.4.4 Notwithstanding any other provision of the Contract Documents, partial payments made pursuant to this **Section 9.4** constitutes neither acceptance of any Defective Work, nor a waiver of any rights set forth in the Contract Documents or otherwise provided by Applicable Law.

9.4.5 The Contracting Authority and Owner may audit Contractor Payment Requests as described under **Section 7.9**.

9.5 Labor Payments

9.5.1 Partial payments to the Contractor for labor shall be made at the rate of 92 percent of the amount invoiced through the Contractor Payment Request that shows the Work is 50 percent complete.

9.5.2 After the Work is 50 percent complete, as evidenced by payments of at least 50 percent of the Contract Sum including approved Change Orders to date, no additional funds shall be retained from payments for labor.

9.5.3 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 Material Payments

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

9.6.2 The Owner shall pay the Contractor at the rate of 92 percent of the invoice cost, not to exceed the scheduled value in a Unit Price or lump sum Contract, 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:

9.6.2.1 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

9.6.2.2 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.

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

9.6.3 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.

9.6.3.1 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.

9.7 Retainage

9.7.1 If the total Contract Sum is \$15,000 or more, when the Contract is 50 percent complete, all funds retained for faithful performance of the Work, in accordance with **Section 9.5.1**, shall be deposited in an escrow account with a bank in the state in accordance with the terms and conditions provided in an escrow agreement executed by the Contractor, Contracting Authority, and applicable bank.

9.7.2 When the Contractor has achieved Substantial Completion of all Work, and there is no other reason to retain funds; upon request of the Contractor, the funds retained in connection with that Work shall be released from escrow and paid to the Contractor, withholding only that amount necessary to assure faithful completion in the sole discretion of the Contracting Authority, including but not limited to compliance with **Section 6.25.2**.

9.7.3 Upon consent by the Contractor's Surety, the Contracting Authority may reduce the amount of funds retained for the faithful performance of Work by 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:

9.7.3.1 completion of the Work;

9.7.3.2 all interference, disruption, hindrance, and delay claims;

9.7.3.3 all Liquidated Damages; and

9.7.3.4 all additional expenses incurred by the State.

9.7.4 If the Project involves more than one Phase as explicitly identified in the Agreement, this **Section 9.7** will apply on a per-Phase basis.

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 decline to approve any Contractor Payment Request or part thereof, or nullify 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 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.

9.9 Final Contractor Payment Request

9.9.1 The Contractor, as a condition precedent to execution of the Certificate of Contract Completion and to 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 be 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

Contract Sum	Each Claim	Annual Aggregate
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. The insurance shall include the following minimum requirements:

10.3.12.1 all-risk basis including war risk and all forms of terrorism;

10.3.12.2 coverage for general average and salvage charges;

10.3.12.3 "on deck" coverage;

10.3.12.4 warehouse-to-warehouse coverage;

10.3.12.5 coverage to include losses from strikes, riots, and civil commotions ("SR&CC coverage");

10.3.12.6 coverage to include losses from free of capture and seizure warranty ("FC&S Warranty coverage");

10.3.12.7 "Inchmaree" clause;

10.3.12.8 sue and labor;

10.3.12.9 "both-to-blame" coverage;

10.3.12.10 free of particular average;

10.3.12.11 inland coverage including on-land shipment, port storage, and barge transit upon inland waterways; and

10.3.12.12 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 8**, the Contract Sum and Contract Times shall be adjusted for increases in the cost and time caused by the suspension, delay, or interruption. The adjustment of the Contract Sum, however, shall not include profit (a component of Contractor's Fee).

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 ten days' 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 place no further orders and enter into no further subcontracts for materials, labor, services, or facilities, except as necessary to complete continued portions of the Project;

11.2.2.3 terminate all subcontracts and orders to the extent they relate to the Work terminated;

11.2.2.4 proceed with Work not terminated; and

11.2.2.5 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 Upon termination, the Contracting Authority shall pay the Contractor in accordance with the Schedule of Values for Work completed, including 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 The Contractor is entitled to a fair and reasonable profit for Work performed and reasonable expenses directly attributable to termination of the Contract. In no event shall the Contractor be entitled to **(1)** Contractor's Fee on 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, or 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 6.23.1** 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 6.23.1** 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 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 State has paid.

11.3.5 If the Contract is terminated, the Contractor shall not be entitled to further payment. If the unpaid balance of the Contract Sum exceeds 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.

11.3.6 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.

11.3.7 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.

11.3.8 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 must 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 (in native format) 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/translate 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 sent by facsimile, email, or web-based project management software, provided the original, signed document is delivered within three business days after the date of the electronic transmission.

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 by **Section 12.8.4**.

12.8.3 The standard workdays for State projects are Monday through Friday, excluding legal holidays.

12.8.4 Legal holidays are as follows:

12.8.4.1 New Year's Day – First Day in January;

12.8.4.2 Martin Luther King Jr. Day – Third Monday in January;

12.8.4.3 Washington-Lincoln (President's) Day – Third Monday in February;

12.8.4.4 Memorial Day – Last Monday in May;

12.8.4.5 Juneteenth Day – Nineteenth Day of June;

12.8.4.6 Independence Day – Fourth day of July;

12.8.4.7 Labor Day – First Monday in September;

12.8.4.8 Columbus Day – Second Monday in October;

12.8.4.9 Veterans' Day – Eleventh Day of November;

12.8.4.10 Thanksgiving Day – Fourth Thursday of November; and

12.8.4.11 Christmas Day – Twenty-fifth day of December.

12.8.5 If a legal holiday falls on a Saturday, it is observed on the preceding Friday. If a legal holiday falls on a Sunday, it is observed on the following Monday.

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 Notice to Proceed establishes the date for commencement of the Work.

12.9.1.2 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 Contract Completion within the associated Contract Time.

12.9.1.3 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.

12.9.1.4 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. If there are any inconsistencies between the provisions of the Contract Documents and the provisions of the Contract, the provisions of this Contract shall prevail.

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 web-based 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 6.2.3** through **6.2.6** 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 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

SECTION 01 11 00
SUMMARY OF WORK

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to the Section.

1.02 PROJECT IDENTIFICATION

- A. General: Project name is **GREAT COUNCIL OBSERVATION TOWER**, as shown on Contract Documents prepared by Schooley Caldwell Associates.
- B. The OWNER is:

OHIO DEPARTMENT OF NATURAL RESOURCES
2045 Morse Road Service Road
Columbus, OH 43229
- C. The ARCHITECT/ENGINEER is:

SCHOOLEY CALDWELL
Architects/ Planners/Interior Designers
300 Marconi Blvd., Suite 100
Columbus, OH 43215
- D. The CONTRACTING AUTHORITY is:

OHIO FACILITIES CONSTRUCTION COMMISSION
30 West Spring Street, 4th Floor
Columbus, OH 43215
- E. CONSULTANTS:

ADVANCED ENGINEERING CONSULTANTS
1405 Dublin Road
Columbus, OH 43215

THE KLEINGERS GROUP
350 Worthington Rd., Suite H
Westerville, OH 43082

SMBH
1166 Dublin Road #200
Columbus, OH 43215
- F. The CONTRACT DOCUMENTS for the Project were prepared by the Architect. Contract Documents are dated September 4, 2025.
- G. Contract Documents indicate the work of the Contract and related requirements and conditions that have an impact on the project. Related requirements and conditions that are indicated on the Contract Documents include, but are not necessarily limited to, the following:
 - 1. Existing site conditions and restrictions on use of the site.
 - 2. Work to be performed subsequent to work under this Contract.
 - 3. Requirements for Owner occupancy during the Work.
- H. Summary by References: Work of the Contract can be summarized by references to the Agreement, General Conditions, Specification Sections, Drawings, Addenda and Modifications to the contract documents issued subsequent to the initial printing of this project manual and including, but not necessarily limited to, printed material referenced by any of these. It is recognized that work of the

Contract is also unavoidably affected or influenced by governing regulations, natural phenomenon including weather conditions and other forces outside the contract documents.

1.03 PRIME CONTRACT

- A. The project will be constructed under a general prime contract contracting arrangement.

1.04 SUMMARY OF WORK

- A. The project will introduce two new freestanding structures to the site: an observation tower and a restroom building. The restroom building will serve visitors with separate men's and women's facilities, as well as a fully enclosed, ADA-compliant family restroom. Standing approximately 48 feet tall, the observation tower is designed to enhance the visitor experience by providing a unique amenity and offering panoramic views of the Great Council State Park. In addition to the new construction, the existing maintenance garage near the restroom building and tower will be renovated to support the overall complex.
- B. Connecting the two new structures will be an outdoor garden and plaza that combines decorative concrete paving with ornamental plantings and comfortable seating areas. From the plaza, visitors will be able to access the larger park through a multiuse asphalt pathway and drive. This pathway will provide both convenience and accessibility, ensuring full ADA compliance while linking the complex back to the public right-of-way.

1.05 CONTRACT DOCUMENTS

- A. The Contract Documents are defined in the Agreement.
- B. Project work shall be executed in accordance with the Contract Documents. Provide items, articles, materials, equipment, operations or methods listed, required to be provided by reason of the drawings or any part of the other Contract Documents, including all labor, materials, equipment and incidentals required or necessary for completion within the time specified in the Contract Documents.
- C. Contractors and subcontractors are responsible for careful examination of all of the Contract Documents to ascertain the full extent of the work under their contract. Work installed under the Contract that must be changed, and which could have been avoided by the foregoing reference, shall be changed and paid for by the Contractor.

1.06 PROJECT CONDITIONS

- A. Supply, install, and maintain barriers, protection, warning lines, lighting, and personnel required to segregate the work area(s) from pedestrian or vehicular traffic, as well as to prevent damage to the surrounding landscaped and paved areas. Observe all applicable OSHA requirements.
- B. Supply labor, equipment, tools and appliances necessary for the proper completion of the work.
- C. Schedule, execute, and coordinate work on a daily basis so that components are installed completely and permanently as specified.
- D. Supply shoring, supports, and other items or materials necessary to brace and support the structure, fixtures, and facilities affected by the work.
- E. Work shall be performed in accordance with applicable Federal, State, and local code requirements and publications.
- F. Coordinate the work in this Section with other Sections, including preparatory work, building protection, daily clean-up, and protection of building, with occupants.

1.07 PRECONSTRUCTION CONFERENCE

- A. A preconstruction conference will be scheduled which will include the Contractor, Architect, Manufacturers Representatives and involved trades to discuss all aspects of the project. The Contractor's foreman or field representative will attend this conference. The foreman must be on site at all times that work is performed.
- B. Delivery of materials and commencement of construction shall not proceed until the preconstruction conference is held. Delays in obtaining a complete set of submittals shall not extend the contracted completion date.

1.08 CONSTRUCTION SCHEDULE

- A. Proper coordination of all aspects of the work by the Contractor and any sub-trades is critical to ensure proper installation and performance of the work. The Contractor's Construction Schedule shall clearly outline the coordination between job tasks of all involved disciplines. Subject to review and acceptance by the Owner, this Schedule will be strictly adhered to by the Contractor and sub-trades.
- B. The Contractor's Construction Schedule shall clearly identify the on-site crew foreman and the size of the crew to be utilized. The crew size shall remain consistent and work shall be continuous throughout the project, from start-up to completion.
- C. The Architect will review the Contractor's Construction Schedule prior to the start of any work. It shall be the responsibility of the Contractor to supply the Owner with written notice, 72 hours in advance, if his work location(s) for a workday is different from the schedule. Update the Construction Schedule weekly and submit a copy to the Owner for review.

1.09 PERMITS, INSPECTION AND TESTING REQUIRED BY GOVERNING AUTHORITIES

- A. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any portion of the Work to be inspected, tested, or approved, the Contractor shall give the Architect and such Authority timely notice of its readiness so the Architect may observe such inspection and testing.
- B. Procure and pay all permits required, licenses and approvals necessary for the execution of this contract and is responsible for all fees for each building permit inspection. Building permit to be submitted and paid by the Architect.
- C. Permits:
 - 1. National Pollutant Discharge Elimination System ("NPDES") Storm Water General Permit.
 - a. The Contractor shall comply with all requirements and conditions of the NPDES general permit, including, but limited to, implementing and maintaining the sedimentation and erosion control measures specified in the storm water pollution prevention plan prepared by the Contractor pursuant to Section 5.2.4 (and as changed within the Supplementary Conditions), which are related to the Work, maintaining records of the its construction activities, removing material no longer required, and taking proper action if there is a reportable quantity spill.
 - b. Unless otherwise stated in the Bid Documents, the Contractor 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.
 - c. Unless otherwise provided in the Bid Documents, the Contractor shall prepare and certify a storm water pollution prevent plan to provide sedimentation and erosion controls to the project.
 - d. The Contractor shall prepare and process the required Notice of Termination ("NOT") prior to Contract Completion.
 - 2. Any permits directly relating to Contractor's Scope of Work.

1.10 REFERENCE STANDARDS

- A. For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. The date of the standard is that in effect as of the bid date, except when a specific date is specified.
- C. Obtain copies of standards when required by Contract Documents. Maintain copy at job sit during

1.11 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the **CSI MasterFormat™ 2020 Edition** 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; based on the

types of work required for this project. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.

- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Division 01 specification sections govern the execution of all Sections of the Specifications.
- D. 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 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. All instructions in the Specifications are addressed to the Contractor unless the responsibility of the Owner or Architect is clearly indicated.
 - 3. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor 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.
 - 4. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 5. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
- E. Drawing Coordination: Requirements for materials, products and equipment identified on Drawings are described in detail in the Project Manual. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
 - 3. Keynoting: Materials and products may be identified by keynotes referencing work within the Specification Section identified in this Project Manual.
 - 4. General Notes: Notes that apply to the entire work. As such, general notes apply equally to all disciplines and to all sheets within the drawing set.
 - 5. Coded Notes: Notes that apply to the specific discipline on the drawing sheets in which these notes appear.
- F. Definitions: Definitions are described in specific locations in the specifications.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 14 00
WORK RESTRICTIONS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to the Section.

1.02 SUMMARY

- A. Section includes:
 - 1. Conduct of work
 - 2. Existing utility interruptions
 - 3. Contractor use of the premises
 - 4. Access to site
 - 5. Work restrictions
 - 6. Miscellaneous restrictions
 - 7. Debris control and removal of rubbish
 - 8. Owner's occupancy requirements

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 CONDUCT OF WORK

- A. The Contract Site shall be as shown on the Drawings, and shall include the entire area bound by the "Contract Limit" or "Limit of Work" lines as well as all areas outside of the Limit of Work Lines when required for performance of work under this Contract.
- B. Take all steps necessary to protect existing conditions to remain. Damage to existing work caused by Contractor's operations under this Contract shall be repaired at Contractor's expense.
- C. Any street, paving, curb and/or sidewalk damaged as the result of work under this Contract, whether within or outside the limits of the Work, shall be repaired and/or replaced with new matching construction at Contractor's expense and in a manner satisfactory to the authorities having jurisdiction.
- D. Protection of Curbs and Walkways: Where existing curbs or walks are to remain, or after new curbs or walks are constructed and trucking is required over them, they shall be suitably protected as shown on approved Logistics Plan.
- E. Trenching and other work outside construction limits shall be expedited to the fullest and carried out with minimum of inconvenience to normal operations of Owner and public traffic. Walks, paved or landscaped areas over which temporary driveways cross shall, upon completion of the Work, be restored to their original condition with new construction. Temporary roadways shall be bridged over trenched areas.

3.02 EXISTING UTILITIES

- A. 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. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.

- B. Immediately repair any active existing utility lines (cables, conduit, ducts, and piping), damaged during the course of construction. Protect and maintain such active existing utilities in use, until relocation of same has been completed or utilities have been cut, capped, or pre-pared for new service connections, as applicable. Perform such repair and protection work at no additional cost to the Owner.
- C. If any existing active utility not indicated on the Drawings is unintentionally damaged, and such utility is to remain, immediately repair the damage and restore the utility to its original integrity. Reimbursement of cost for performing such repair will be made by an adjustment in the Contract Price in accordance with the General Conditions of the Contract.
- D. If it becomes necessary to interrupt power, water line, sewer, gas or other utilities to adjacent buildings, notify the Owner's Project Manager at least four (4) days in advance.
- E. Schedule such interruptions at such times as will minimize disruption and inconvenience to users.
- F. Whenever it becomes necessary to interrupt existing services in use by the Owner, 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 basis until that Work is completed and the service restored.

3.03 CONTRACTOR USE OF PREMISES

- A. Confine operations at the site to the areas within the construction limits. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction.
- B. Cooperate with the Owner regarding site utilization matters to achieve maximum practical use of the site while maintaining essential uses of the site and building by the Owner. Performance of work shall not interrupt the day to day operation of the Owner and shall not decrease the safety and security of its staff and the public.
- C. On-Site Work Hours: Work shall be generally performed inside the building during normal business working hours of 7AM – 5PM weekdays and no work on Sundays and Holidays. Comply with local noise ordinance. Contractor shall be required to seek work hour variance for requested/planned Work on-site outside of the hours above.
- D. Supervise the work and be solely responsible for construction means, methods, techniques, sequences, dimensions and procedures and for coordinating all portions of the Work. Construction techniques or activities which decrease the building security or safety are not permitted. Coordinate fully with the Owner's requirements regarding security and safety of the building and premises.
 - 1. Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.
- E. Deliver and store materials and construction equipment to the limited exterior areas designated by Owner for such storage use. Contractor should plan to deliver bulk materials to the site on an as needed basis. Such materials and equipment shall be arranged in a neat and orderly manner, and away from pedestrian or automobile traffic. No interior storage shall be permitted. The storage area shall be barricaded by the Contractor to indicate that it is a restricted area.
 - 1. Limit use of site for work and storage as follows:
 - a. Do not use existing/completed paved areas for storage without Owner's approval.
 - b. Do not store materials within 25 feet of new or existing trees.
 - c. Restrict work and storage to areas indicated on drawings or approved by Owner.
 - d. Limit site access and parking to locations approved by Owner.
 - e. Do not perform operations that would interrupt or delay Owner's daily operations.
- F. Restore property of the Owner to its original condition prior to the start of construction. Refer to "Final Cleaning" section of Section 01 77 19 – Closeout Requirements. General clean-up of the site shall be performed on a daily basis.
- G. Take all actions necessary to prevent damage to the property and to protect the buildings during the construction period. Damage to building or building sites due to or caused in conjunction to the contracted work shall be the responsibility of the Contractor to repair the damage.
- H. Contractor and subcontractors shall be responsible for the protection and security of their own equipment, materials, and tools.

- I. Do not dispose of materials on site by burial, burning, or other means.
- J. Maintain access for firefighting equipment and access to fire hydrants.

3.04 ACCESS TO SITE

- A. General: Use of the site is limited for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Use of Site: Limit use of Project site to locations/areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated, unless required to complete the work.
- C. Work outside of the primary construction area shall be scheduled with the Owner sufficiently in advance and performed on a premium time basis, unless stipulated otherwise.
- D. Access to the site is limited to authorized construction personnel with proper identification and clearances during scheduled hours.
- E. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to the areas indicated. If additional storage is necessary, obtain and pay for such storage off-site.
- F. Take steps necessary to protect adjacent and existing facilities (buildings, infrastructure, real estate, equipment, etc.) and planting during the course of the project. Any damage will be repaired, and restored to original condition by the Contractor to the satisfaction of the Owner and Architect.

3.05 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, rights of way, and with other requirements of authorities having jurisdiction.
- B. Noise, Dust, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration; odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- C. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
- D. Controlled Substances: Use of tobacco products and other controlled substances within the Project site is not permitted.
- E. Personnel Restrictions:
 - 1. Employee Behavior: Workers shall conduct themselves in a business-like manner at all times.
 - 2. Restrict area for employee breaks and eating. Keep site clean.
 - 3. No radios/music or foul language will be allowed.
 - 4. No catcalls or other offensive language directed to the Owner's employees, visitors or the public will be permitted.
 - 5. All contractors must wear shirts.

3.06 MISCELLANEOUS

- A. Codes: Comply with applicable codes and regulations of authorities having jurisdiction. Submittal copies of inspection reports, notices, and similar communication to the Architect.
- B. Explosives: Use of explosives and blasting will not be permitted.

3.07 DEBRIS CONTROL AND REMOVAL OF RUBBISH

- A. Ensure that each Subcontractor engaged in the Work bears full responsibility for cleaning up during on a daily bases and immediately upon completion of his work, and removes all rubbish, waste, tools, equipment, and appurtenances caused by and used in the execution of his work; but this shall in no way be construed to relieve the Contractor of primary responsibility for maintaining site free of debris, and in a condition satisfactory to the Owner..

- B. Immediately after unpacking, remove all packing materials, case lumber, excelsior, wrapping and other rubbish, flammable and otherwise, from the building and premises.
- C. Initiate and maintain a specific program to prevent the accumulation of debris at the construction site, storage and parking areas, or along access roads and haul routes: Provide containers for deposit of debris and schedule periodic collection and disposal of debris. Prohibit overloading of trucks to prevent spillage on access and haul routes.

3.08 OWNER'S OCCUPANCY REQUIREMENTS

- A. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion dates, 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. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
 - 3. 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.
 - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

END OF SECTION

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for product substitutions.
- B. Related Sections include the following:
 - 1. Drawings and general provisions of the Contract, including General Conditions and Division 01 specification sections, apply to work of this section.
 - 2. Section 01 60 00 – Product Requirements: Product options which authorize a substitution request form.
 - 3. Individual Technical Sections: Expressed restrictions related to substitutions.
- C. Attachments following this section:
 - 1. Substitution Request Form (01 25 00A)

1.02 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents. Proposed by Contractor.
- B. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.
- C. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions". The following are NOT considered substitutions:
 - 1. Substitutions requested by Bidders during the bidding period, and accepted prior to award of Contract, are considered as included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
 - 2. Revisions to Contract Documents requested by the Owner or Architect.
 - 3. Specified options of products and construction methods included in Contract Documents.
 - 4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.03 SUBSTITUTION PROCEDURES

- A. General: If the proposer or Contractor desires approval of some material or product other than that specified, submit a written request for approval of the substitute item in accordance with the following requirements:
 - 1. Architect will consider substitutions after 15 days of Contract award only if one of the following conditions applies.
 - a. Specified products are no longer manufactured.
 - b. Owner will realize an additional cost savings over and above the original Bid cost.
 - c. Owner will receive a superior product to those specified and/or realize a significant maintenance and operating cost savings.
 - d. Overall construction time will be reduced (not just the time for the trade offering the substitution..
 - 2. All such requests must be made on the Substitution Request Form; see attached at end of this Section.
 - 3. Requests received after this time will not be reviewed or considered. No request for approval will be considered unless submitted in accordance with this Section.
 - 4. Final decision as to whether an item is an equal or satisfactory substitution rests with the Architect.
 - 5. Clearly mark manufacturer's literature to indicate equality in performance and appearance.

- B. Substitution Requests: Every substitution request must state whether the item offered is equivalent to the specified product. The substitute material or product must be accompanied by its reference in the Contract Documents and complete catalog, technical and other information, as appropriate. In addition to requirements indicated on the Substitution Request Form, comply with following:
1. As required, include samples showing comparison of physical and other pertinent characteristics as required to establish equivalence of acceptability for the proposed application. This will require also providing data of the material or product specified to provide a side by side comparison.
 2. Where specific test results are required by the Contract Documents, the comparison data for the proposed item shall be based upon the same test methods as those specified, or they shall be correlated to clearly demonstrate comparability.
 3. The same guarantee/warranty described for the specified product is required for the substitution.
 4. Coordination information, including a list of changes or modifications needed to other parts of the Work that will become necessary to accommodate the proposed substitution.
 5. Cost information, including net change, if any.
 6. Contractor shall accompany any request for substitution with such drawings, specifications, samples, manufacturer's literature, performance data, and other information necessary to describe and evaluate the proposed substitution completely. The burden of proof shall be on the Contractor.
 7. As required, provide references of three (3) similar projects where proposed substitute product has been used successfully, on a separate sheet, include names, addresses, date of installation and contact name of Owner or facilities manager.
- C. Coordination And Redesign: In making request for approval of substitute materials, the Contractor must represent that it has investigated the proposed product and, in its opinion, it is equivalent in all respects to that specified. Also, Contractor will coordinate all trades including changes thereto as may be required, that it waives all claims for additional costs or time extension for Completion which subsequently become apparent as a consequence of the substitution and that it will bear all costs related hereto, including costs of Architect's services for redesign if deemed necessary.
1. If any substitution will affect a correlated function, adjacent construction, or the work of other trades or contractors, the necessary changes and modifications to the affected work shall be considered as an essential part of the proposed substitution, to be accomplished by the Contractor without additional expense to the Owner if and when accepted.
- D. Substitutions WILL NOT be considered if:
1. They are indicated or implied on Shop Drawings or other project data submittals, without proper notice shown on attached form.
 2. Substitutions are not submitted in conformance with this Section.
 3. Acceptance will require substantial revision to the Contract Documents, or building spaces.
 4. Request for substitution does not indicate specific item for which request is submitted.
 5. Substitution Request Form is not properly executed
 6. Acceptance of manufacturer only will not be made.
 7. Requested directly by a Subcontractor or supplier.
 8. Insufficient information submitted.

1.04 ARCHITECT'S ACTION

- A. Architect's Action: Within one week of receipt of the request for substitution, the Architect will request additional information or documentation necessary for evaluation of the request. Within two weeks of receipt of the request, or one week of receipt of the additional information or documentation, whichever is later, the Architect will notify the Contractor of acceptance or rejection of the proposed substitution. Acceptance will be in the form of a Change Order.
1. If a decision on use of proposed substitute cannot be made or obtained within the time allocated, use the product specified by name.
- B. The Contractor's submittal and Architect's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Architect's Process: Unless it is mutually agreed to utilize web-based Construction Contract Administration (CCA) software system for tracking and responding to communications between the Architect and the Contractor, documents will be transmitted as PDFs via email or FTP. Documents will be sent as PDF or other standard format (MS Word, Excel, JPEG, etc.) via email or the Architects FTP site.
 - 1. Contractor shall prepare requests and submittals on electronic forms acceptable to Architect and Owner provided the data included is consistent with the Substitution Request Form included after the end of this Section.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 25 00A
SUBSTITUTION REQUEST FORM

TO: Phillip Sour
Schooley Caldwell Associates
Email: psour@schooleycaldwell.com

PROJECT: Great Council Observation Tower
SC Project No. 24410.00

A proposed substitution cannot legally be included in a bid or used in the Work until it appears in an Addendum or other Contract Modification as defined in the General Conditions. See "Invitation to Bid" and Section 01 60 00 – Product Requirements.

PROVIDE THE FOLLOWING INFORMATION. FAILURE TO PROVIDE THE INFORMATION COMPLETELY WILL BE CAUSE FOR REJECTION OF THE SUBSTITUTION.

SPECIFIED PRODUCT:

Specified Product: _____

Specified Manufacturer: _____

Specification Section: _____ Page: _____ Article: _____ Paragraph: _____

PROPOSED PRODUCT:

Product Name: _____

Manufacturer Name: _____

Manufacturer Web site: _____

QUESTIONS:

Answer the following questions using a separate attachment:

In your opinion, is the proposed product equivalent to the specified product?

Are the product characteristics the same as the specified product? (Dimensions, material properties?)

Are the product warranties the same? If not, list differences (Include attachment documenting warranty).

Does the proposed product require modifications to the building construction details?

Color: Is the same color available at no upcharge? Is another color selection required that doesn't match the specified product?

Will the construction time be affected if this proposed product is approved?

Has the proposed product been used locally?

Name of Facility: _____

Address: _____

Contact Person: _____ Phone: _____

Is product represented locally?

Supplier/Representative: _____ Phone: _____

Are approved installer(s) available locally?

Approved Installer(s): _____

Provide an attachment that lists a minimum of three similar projects completed by each installer. Include contact name and telephone number.

ATTACHMENTS:

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other

Include the following attachments:

1. Copy of the Project Manual Section where the proposed equal product would be specified, rewritten or red-lined to include any changes necessary to correctly specify the proposed equal product. Identify completely changes necessary to the original Project Manual Section.

2. Copies of details, elevations, cross-sections, and other elements of the Construction Drawings redone as necessary to show changes necessary to accommodate proposed equal product. Identify completely the changes from the original Drawings.
3. Complete product literature and technical data, installation and maintenance instructions, test results, and other information required to show complete conformance with requirements of the Contract Documents.

CERTIFICATION:

Signature on this document provides that the proposer certifies that the following statement and accompanying attachments are true:

1. Substitute product has been fully investigated and determined to be equal or superior in all respects to the specified product performance.
2. Same warranty will be furnished for proposed substitution product as for specified product.
3. Same maintenance service and source of replacement parts, as applicable, is available.
4. Proposed equal product will have no effect on other trades and will not affect or delay progress schedule.
5. Proposed equal product does not affect dimensions and functional performance values.
6. Payment will be made to the Architect for changes to building design, including Architect design, detailing, and construction costs caused by the substitution.
7. The undersigned further states that the function, appearance, and quality of the proposed product are equivalent or superior to the specified item:

Submitted by: _____

Signature: _____

Typed Name: _____

Company: _____

Address: _____

_____ Zip Code: _____

Telephone: _____ Fax: _____

Attachments (List): _____

ARCHITECT REVIEW AND ACTION: (For use of the Architect only)

- _____ Proposed product accepted.
- _____ Proposed product not in compliance with instructions. Respond to attached comments and resubmit.
- _____ Proposed product not acceptable. Use specified product(s).
- _____ Not Reviewed. Submission received too late. Use specified product(s).

ADDITIONAL REVIEWER COMMENTS: (For use of the Architect only)

END OF SECTION

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
 - 1. Drawings and general provisions of the Contract, including General Conditions and Division 01 specification sections, apply to work of this section.
 - a. Article 7 Modifications of the General Conditions.

1.02 MINOR CHANGES IN THE WORK

- A. Per Article 3.1.1.2 of the General Conditions, the Architect will issue through supplemental instructions, authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, or both.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Architect's Process: Unless it is mutually agreed to utilize web-based Construction Contract Administration (CCA) software system for tracking and responding to communications between the Architect and the Contractor, documents will be transmitted as PDFs via email or FTP. Documents will be sent as PDF or other standard format (MS Word, Excel, JPEG, etc.) via email or the Architects FTP site.
 - 1. Prepare requests and submittals on electronic forms acceptable to Architect and Owner.

1.04 PROPOSAL REQUESTS FOR CHANGES IN THE WORK

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time or on date specified in the proposal request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. No lump sum amounts are permitted. Detailed breakdown of costs are required, broken down by labor and materials, etc.; and including prime, subcontractor, sub-subcontractor and/or supplier pricings.
 - c. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Use electronic form acceptable to Architect.
- B. Contractor-Initiated Proposal Requests: If latent or changed conditions require modifications to the Contract, Contractor may initiate a change by submitting a written request to the Architect accompanied by a Proposal.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 25 00 – Substitution Procedures if the proposed change requires substitution of one product or system for product or system specified.
7. Use electronic form acceptable to Architect.

1.05 CHANGE ORDER PROCEDURES

- A. Refer to ¶7.2 of the General Conditions.

1.06 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive to instruct Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time or both.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.
 2. To expedite decisions about changes, Contractor is strongly encouraged to use digital photographs or still photographs to transmit information about existing conditions to the Architect's office.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 26 13
REQUESTS FOR INFORMATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Requests for Information.
- B. Related Sections include the following:
 - 1. Drawings and general provisions of the Contract, including General Conditions and Division 01 specification sections, apply to work of this section.

1.02 DEFINITIONS

- A. Definitions used in this article are not intended to change or modify the meaning of other terms in the Contract Documents.
- B. Request for Information (RFI): A request for information by the Contractor to the Architect for clarification of intent of any portion of the Contract Documents after the award of Contract and during the construction phase of the Project.
- C. The following are NOT Requests for Information:
 - 1. Change Orders.
 - 2. Substitution Request.
 - 3. Bulletin.
 - 4. Field Order.
 - 5. Shop Drawings.
 - 6. Normal questions contained in a typical shop drawing submittal.
 - 7. Clarifications during bidding.

1.03 REQUESTS FOR INFORMATION (RFI'S) DURING CONSTRUCTION

- A. RFI's are logged-in at the Architect's Office, not necessarily with same date as indicated by the Contractor on RFI form. The response time will commence upon the date of receipt by the Architect.
 - 1. Copies of RFI's sent by the Contractor and received by the Architect after 2:00 p.m. will be considered received the following Monday, holidays excepted at 8:00 a.m. and are to be dated as such.
- B. Requests for Information (RFI): If clarification of any portion of Construction Documents is required, submit a Request for Information to the Architect in accordance with the following procedures:
 - 1. RFI Format:
 - a. Submit on a standard form developed by the Architect.
 - b. RFI's shall be sequentially numbered; and include the following:
 - 1) Project name.
 - 2) Project number.
 - 3) Date.
 - 4) Name of Contractor.
 - 5) Name of Architect.
 - 6) RFI number, numbered sequentially.
 - 7) RFI subject.
 - 8) Specification Section number and title and related paragraphs, as appropriate.
 - 9) Drawing number and detail references, as appropriate.
 - 10) Field dimensions and conditions, as appropriate.
 - 11) Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

- 12) Contractor's signature.
 - 13) Adequate space for Architect to respond, sign, and date.
 - 14) Attachments: Include sketches, descriptions, measurements, photos, Product Data, and other information necessary to fully describe items needing information.
 - a) Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
 - b) Attachments shall be electronic files in Adobe Acrobat PDF format.
- C. Submit a copy of the format to the Architect at start of Project for review and comment.
- D. RFI Procedure:
1. Clearly state and completely define the issue requiring information.
 2. Each RFI shall address one subject or issue.
 1. Each RFI shall contain specific reference to the drawing number(s), detail number(s), schedule type(s), bulletin number(s), specification section(s) and paragraph number(s), or other related document(s) which is (are) pertinent to the Contractor's question. The date of each referenced drawing number, bulletin, specification section, or other related document shall be identified. In preparing each RFI verify the applicable dimension(s), field conditions, drawing requirements (small through large-scale details), and/or specification section requirements pertaining thereto.
 2. Prior to submission of an RFI coordinate the nature of the inquiry with the requirements of other sections or trades as related thereto, as well as responses to previous RFI's. Where supplementary sketches are required to clarify an inquiry the Contractor shall attach supplementary sketches, at large scale, illustrative of the inquiry. Sketches shall include sufficient detail, materials, dimensions, thicknesses, assembly, attachments, relation to adjoining work, structural grid references, and all other pertinent data and information for the Architect to make an informed response.
 - a. The Contractor is encouraged to suggest solution(s) to its inquiries, if applicable.
 - a. Should the Contractor's solution(s) have an impact on Contract Sum or Contract Time it shall be so stated within the RFI. Provide cost and schedule implications, if any.
 3. Ambiguous RFI's will be returned to Contractor without action taken.
- E. RFI Submission Process:
1. Submit an RFI, in writing, to the Architect immediately when any issue requiring clarification arises.
 - a. Unless specifically stated on RFI, the Architect will assume adjustments to the Contract Amount and the Project Schedule are NOT REQUIRED.
 2. The Architect will review and respond only to RFI's received in writing from the General Contractor.
 3. Submit electronic copies of each RFI and Architect response, including any supplemental drawings and additional instructions, to the Architect for record purposes.
 4. RFI's submitted to the Architect of without following these submission procedures will result in rejection of the submission.
- F. RFI Log:
1. Maintain an RFI log indicating the RFI number, subject, date, response date and impact, if any on schedule and cost.
 2. Publish the log at least bi-monthly to the Architect.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 31 00
PROJECT COORDINATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General project coordination procedures.
 - 2. Project coordination
 - 3. Project meetings and conferences
 - 4. Administrative and supervisory personnel.
 - 5. Digital Project Management Procedures
 - 6. Coordination drawings.
- B. Each subcontractor shall participate in coordination requirements. Although certain areas of responsibility may be assigned by contract to a specific subcontractor, the Contractor shall be responsible for the overall coordination of all the work.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Drawings and general provisions of the Contract, including General Conditions and Division 01 specification sections, apply to work of this section.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Architect's Process: Unless it is mutually agreed to utilize web-based Construction Contract Administration (CCA) software system for tracking and responding to communications between the Architect and the Contractor, documents will be transmitted as PDFs via email or FTP. Documents will be sent as PDF or other standard format (MS Word, Excel, JPEG, etc.) via email or the Architects FTP site.
 - 1. Prepare requests and submittals on electronic forms acceptable to Architect.

1.03 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner's Representative and sub-contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's Construction Schedule.
 - 2. Preparation of the Schedule of Values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.

6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.04 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - e. Indicate required installation sequences.
 - f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit **1-1/4 inches** in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.

- c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
- 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
- 9. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 - 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 - 2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.

1.05 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Web-Based Project Software: Provide, administer, and use web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.
 - 1. Web-based Project software site includes, at a minimum, the following features:
 - a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
 - 2. Provide up to seven web-based Project software user licenses for use of Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for web-based Project software users.
 - 3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
 - 4. Provide one of the following web-based Project software packages under their current published licensing agreements:
 - a. Autodesk; Buzzsaw or Constructware.
 - b. Corecon Technologies, Inc.
 - c. Meridian Systems; Prolog.
 - d. Newforma, Inc.
 - e. Procore Technologies, Inc.
 - f. Viewpoint, Inc.; Viewpoint for Project Collaboration.

- g. Other web-based software as approved.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.06 REQUESTS FOR INTERPRETATION/INFORMATION (RFIS)

- A. Section 01 26 13.

1.07 PROJECT MEETINGS AND CONFERENCES

- A. Refer to General Conditions, Article 6.6
- B. The General Contractor shall schedule job progress meetings with major subcontractors and shall notify the Architect of the time and place of the meeting. Subsequent meetings shall be held on the same day and hour of the week for the duration of the construction period; except, upon instructions of the Architect, the scheduled meetings may be increased or decreased as required by the progress of the work.
- C. Preconstruction Meeting: The Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Contractor and Architect, but no later than three (3) days after Notice to Proceed.
 - 1. Attendees: Architect, and their consultants; Contractor and its superintendent; Quality Control Manager, major subcontractors; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Inspection reports
 - l. Preparation of record documents.
 - m. Use of the premises
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress and final cleaning.
 - 3. Minutes: Contractor responsible for conducting meeting will record and distribute meeting minutes to each party present and to parties requiring information.

- a. **Schedule Updating:** Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- D. **Progress Meetings:** The A/E will conduct weekly job progress meetings. Progress meetings are in addition to specific meetings held for other purposes, such as the preconstruction meeting.
 1. **Attendees:** In addition to representatives of the Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with the project and authorized to conclude matters related to the Work.
 2. Meetings shall be held on the same day and hour of the week for the duration of the construction period; except, upon instructions of the A/E, the scheduled meetings may be increased or decreased as required by the progress of the work.
 3. Notes will be taken by the A/E on discussions and decisions made at each meeting. Written copies of the notes will be distributed to all concerned parties.
 4. **Agenda:** Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. **Contractor's Construction Schedule:** Review progress since the last meeting. Determine whether contract is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. **Schedule Updating:** Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. **Agenda:** Discuss items of significance that could affect progress, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Change Orders.
 - 12) Status of correction of deficient items
 - 13) Field observations
 - 14) Status of RFI's
 - 15) Status of proposal requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.
- E. **Pre-installation Meeting:** General Contractor: Conduct a pre-installation conference at the site before each construction activity that requires coordination with other construction. The installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 1. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
 - a. Contract Documents.
 - b. Options.
 - c. Related Change Orders.
 - d. Purchases

- e. Deliveries.
 - f. Shop Drawings, Product Data and quality control Samples.
 - g. Review of mockups.
 - h. Possible conflicts.
 - i. Compatibility problems.
 - j. Time schedules.
 - k. Weather limitations.
 - l. Manufacturer's recommendations.
 - m. Compatibility of materials.
 - n. Acceptability of substrates.
 - o. Temporary facilities and controls.
 - p. Space and access limitations.
 - q. Governing regulations.
 - r. Safety.
 - s. Inspection and testing requirements.
 - t. Installation procedures.
 - u. Required performance results.
 - v. Recording requirements.
 - w. Protection of adjacent work.
- 2. General Contractor: Record significant discussions and agreements and disagreements of each conference, along with the approved schedule. Promptly distribute meeting records to everyone concerned, including the Owner and Architect.
 - 3. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

F. Special Inspections Meeting:

- 1. In accordance with the, Building Permit, and the requirements of the Authority Having Jurisdiction, a conference(s) will be conducted to review the procedures and work required under the Special Inspections Program.
- 2. Suggested Agenda:
 - a. Discuss the State's requirements for Special Inspections.
 - b. Review proposed Inspection Plan.
 - c. Examine credentials of proposed inspection professionals and testing laboratories.
 - d. Reach an agreement on the Statement and the Schedule of Special Inspections.
 - e. Discuss detection and reporting of critical problems.
 - f. Discuss notification to the State of changes in critical services.
 - g. Review requirements for testing, inspection, observation, reports and certification by the different entities involved.
- 3. Attendance: The following shall attend the special inspections conference:
 - a. Architect.
 - b. Structural Engineer of Record.
 - c. General Contractor.
 - d. Special Inspector
 - e. Professional in charge of Architectural Inspections.
 - f. Geotechnical Inspector; Professional in charge of Geotechnical Services.
 - g. Professional in charge of Structural Inspections (if different from Special Inspector)
 - h. Professional in charge of Materials Testing Laboratory (if different from Special Inspector).
 - i. State Representative for Special Inspections.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

GREAT COUNCIL OBSERVATION TOWER
Great Council State Park
1587 US-68, Xenia, OH 45385

DNR-250004

END OF SECTION

Section 01 32 16 - Construction Progress Schedule

State of Ohio Standard Forms and Documents

PART 1 GENERAL

1.01 SUMMARY

- A. The purpose of the Construction Progress Schedule is to allow the Schedule Manager to prepare an orderly plan to aid in the timely completion of the Project.
 - 1. For clarity, this Section uses the term Schedule Manager for activities performed by the Lead Contractor's Schedule Consultant, the Lead Contractor, the Construction Manager, or the Contractor depending on the party with contractual responsibility for their timely completion in accordance with paragraph 4.2.3 of the applicable General Conditions.
- B. The approved Construction Progress Schedule will be used to plan and execute the work, to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis for all progress payments.
- C. Contractors shall cooperate and coordinate with each other, and with the A/E and the Owner, to provide all scheduling requirements in their respective schedules in accordance with the Contract Documents.
- D. Failure to maintain the Construction Progress Schedule in an approved status may result in the Contracting Authority withholding a monetary penalty against the responsible Contractor(s) until the schedule is approved.
- E. Related Sections:
 - 1. Division 00 Document - General Conditions (Paragraphs 4.2 and 4.3)
 - 2. Division 00 Document - Supplementary Conditions (if applicable)

1.02 PROJECT SCHEDULING SEQUENCE REQUIREMENTS

- A. The Schedule Manager will prepare a Construction Progress Schedule for all work included under the scope of each Contract, in accordance with Subparagraph 4.3.2 of the General Conditions.
 - 1. The Schedule Manager will schedule and conduct a Schedule Kick-Off Meeting. Contractors are required to attend.
 - a. The Schedule Manager will prepare and furnish to all contractors a Master Activity Coding template, in hard copy and disk, defining the Responsibility Code, Work Area Code, Milestones, Phase Code, etc. for the Construction Progress Schedule, as outlined in this section. Contractors shall submit subsequent schedule requirements in accordance with the Master Activity Code template to achieve continuity in merging scheduling input.
 - b. The Schedule Manager will prepare and distribute a schedule framework of proposed construction sequence to the Contractors.
 - 2. The Schedule Manager will prepare and furnish a detailed schedule framework, in hard copy and disk, to the Contractors.
 - a. Contractors shall utilize the detailed schedule framework to prepare their Construction Progress Schedule for their specific scope of work.
 - b. The Schedule Manager will schedule and conduct a minimum of two Schedule Sequence Review Meetings with mandatory attendance by all Contractors to meet the Construction Progress Schedule submission requirement within 60 calendar days after the Notice to Proceed is issued.

- B. Contractors shall provide Construction Progress Schedule requirements specified herein to the Schedule Manager so that they can prepare a fully coordinated Construction Progress Schedule.
 - 1. If the Project utilizes the Stipulated Sum Multiple-Prime Contract model, the Lead Contractor shall include an Allowance for Schedule Consultant Services in their bid and procure Schedule Consultant services to meet these requirements, in accordance with the General Conditions.
 - 2. If the Project utilizes the Stipulated Sum Single-Prime Contract model, the Contractor shall include in their bid and provide scheduling services to meet these requirements, in accordance with the General Conditions.
- C. The Schedule Manager will submit the Construction Progress Schedule through the Lead Contractor, if applicable, with signatures indicating approval by all contractors to the A/E.
 - 1. If acceptable, the A/E and Contracting Authority will accept the schedule.
 - 2. If not acceptable, the schedule will be returned to the Schedule Manager for revision. The revised schedule, with approval signatures for all Contractors, shall be resubmitted.

PART 2 PRODUCTS

2.01 SCHEDULE SOFTWARE

- A. The computer software utilized by the Schedule Manager to produce the project schedule will be Primavera Products as marketed by Primavera Systems, Inc. or a substitution accepted by the Contracting Authority.

PART 3 EXECUTION

3.01 CRITICAL PATH METHOD

- A. The Critical Path Method (CPM) of network calculations will be used to generate the schedule. The Schedule Manager shall provide the schedule in either the Precedence Diagram Method (PDM) or the Arrow Diagram Method (ADM).

3.02 LEVEL OF DETAIL REQUIRED

- A. With the exception of the preliminary schedule submission, the Construction Progress Schedule shall include an appropriate level of detail. Failure of the Schedule Manager to develop or update the schedule or provide resource information will result in the disapproval of the schedule.
- B. Activity Durations:
 - 1. Submit the following data to support the schedule calendar as it relates to durations. Failure of the Schedule Manager to include this data will delay the review of the submittal until the A/E receives the missing data.
 - a. The proposed number of working days per week.
 - b. The holidays to be observed during the life of the contract (by day, month and year).
 - c. The planned number of shifts per day.
 - d. The number of hours per shift.
 - e. Break up the work into activities of a duration no longer than 20 work days each, except as to non-construction activities (e.g., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities for which the Owner may approve a longer duration.
- C. Procurement Activities:

1. Prepare the schedule in chronological order of submittals. Show specification section of the submittal, name of contractor and generic description of work covered. Include activities to cover the complete procurement process to include but not limited to: submittal, review, approval, resubmittal, procurement, fabrication, delivery, permits, and similar pre-construction work.
- D. Manpower:
1. Activities shall have an estimate of the average number of workers per day that are expected to be used during the execution of the activity.
 2. Identification of manpower, material, or equipment restrictions, as well as any activity requiring unusual shift work, such as two shifts per day, six day work week, specified overtime, or work at times other than regular days or hours shall clearly be identified in the Project Schedule.
 3. Critical or near Critical Paths resulting from the use of manpower or equipment restraints shall be kept to a minimum. Near Critical Paths are defined as paths having 10 workdays or less of total float.
- E. Cost:
1. All activities shall be cost loaded in a logical manner tying to each Contractor's Schedule of Values.
- F. Responsibility:
1. All activities shall be identified in the Construction Progress Schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the Contracting Firm, the Subcontracting Firm, Contractor Workforce, or Agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.
- G. Work Areas:
1. Arrange the schedule to show each major area of construction for each major category or unit of work.
 2. All activities shall be identified in the Construction Progress Schedule by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.
- H. Change Order or Claim Number:
1. Any activity that is added or changed by a change order or used to justify any claimed time, shall be identified by change order code that changed the activity. Activities may not belong to more than one change order.
- I. Milestones:
1. Milestone dates are defined in calendar days following the date set forth in the Notice to Proceed and are required to be met by all Contractors. Time is of the essence for the completion of Milestones and for the Contract Completion date.
 2. The following Milestone dates are defined in calendar day from the Notice to Proceed, and shall be adhered to by each Contractor.
 - a. Milestone M1 - < describe >
 - b. Milestone M2 - < describe >
 - c. Milestone M3 - < describe >
- J. Adverse Weather

1. Definitions

- a. Adverse Weather Day: A day when the magnitude of a weather parameter (precipitation or temperature) is such that it creates conditions that inhibit the ability of the contractor to work productively on critical construction activities.
- b. Expected Adverse Weather Days: The number of adverse weather days expected to occur on a monthly basis and defined for two different construction types (1. Grading and 2. Surfacing and Structures).
- c. Unexpected Adverse Weather Days: The number of adverse days that exceed the expected number of adverse weather days determined on a monthly basis. Also number of days with lightning and/or high winds that inhibit the ability of the contractor to work productively on critical construction activities as corroborated by the A/E.
- d. Actual Adverse Weather days: The actual number of adverse weather days that occur during a single month.
- e. Precipitation: Rain, snow, or hail where 1" of rain equals 12" of snow.
- f. Calendar Day is based on all available days including weekends and holidays.
- g. Working Day is based on a five-day work week and exclude weekends and holidays.

2. Methodology

- a. Adverse Weather Days Criteria
 - 1) A single precipitation threshold of greater than 19.05 mm (0.75 inch) the previous day determines an adverse weather day for Type 1 construction
 - 2) A single precipitation threshold of greater than 7.62 mm (0.30 inch) determines an adverse weather day for Type 2 construction.
 - 3) A single precipitation threshold of greater than 7.62 mm (0.30 inch) reached before shut down determines an adverse weather day for Type 2 construction.
 - 4) A single daily maximum temperature threshold of less than 0 degrees C (32 degrees F) determines an adverse weather day for Types 1 & 2 construction.
 - 5) A combination of daily maximum temperature less than 0 degrees C (32 degrees F) and precipitation greater than 7.62 mm (0.30 inch) determines a single adverse weather day.
- b. Expected Adverse Weather Days
 - 1) Calculate the average number of expected adverse weather calendar days per month based on 5 years of data from Columbus, OH posted by The Weather Underground Inc. (wunderground.com) for each construction type.
 - 2) Calculate the average number of expected adverse work days per month by multiplying the average number of expected adverse weather calendar days per month by 5/7.

3.03 SCHEDULED PROJECT COMPLETION

A. Project Start Date:

- 1. The Construction Progress Schedule may start no earlier than the date that the Notice to Proceed (NTP) was issued. The Schedule Manager shall include as the first activity in the Construction Progress Schedule an activity called "Notice to Proceed." The "Notice to Proceed" activity shall have: an "ES (early start) constraint, a constraint date equal to the date that the NTP was issued, and a zero day duration.

B. Constraint of Last Activity:

1. Completion of the last activity in the schedule shall be constrained by the contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the Critical Path. The Schedule Manager shall include as the last activity in the Project Schedule an activity called "Contract Complete". The "Contract Complete" activity shall have a: "LF" (late finish) constraint, a constraint date equal to the completion date equal to the date identified in the NTP for the project, and a zero day duration.

3.04 INTERIM COMPLETION DATES (MILESTONES)

- A. Contractually specified interim completion dates (Milestone dates) shall also be constrained to show negative float if early finish date of the last activity in that phase falls after the interim completion date.

3.05 HAMMOCK ACTIVITIES FOR CONTRACTS

- A. The Schedule Manager shall include a hammock type activity for each Contractor. The Contractor activity shall be logically tied to the earliest and latest activities in the Contractor's Scope of Work. Hammock activities shall be identified within "HA" at the beginning of the Activity ID.

3.06 DEFAULT PROGRESS DATA DISALLOWED

- A. Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in the CPM Scheduling Software Systems. Actual Start and Finish dates and Remaining Durations on the CPM Schedule shall match those dates provided from Contractor Daily Reports for every in progress or completed activity and insure that the data contained on the Daily Reports is the sole basis for schedule updating. Failure to comply may result in the disapproval of schedule.

3.07 OUT OF SEQUENCE PROGRESS

- A. Activities that have posted progress without predecessors being completed (Out of Sequence Progress) shall be allowed only by the case by case approval of the Owner. The A/E may direct that changes in schedule logic be made to correct any or all Out of Sequence Work.

3.08 NEGATIVE LAG(S)

- A. Lag durations contained in the schedule shall not have a negative value.

3.09 DEFINITION OF, AND CONDITIONS RELATING TO FLOAT

- A. Float is defined as the amount of time between the early start date and the late start date, or the early finish date and the late finish date, of any activity in the schedule. Total float is defined as the amount of time any given activity or path of activities may be delayed before it will affect the project completion time.
- B. Float is not time for the exclusive use or benefit of the Contractor, and shall be used in the best interest of completing the project on time.
- C. Extensions of time for performance required under the General Conditions pertaining to equitable time adjustment will be granted only to the extent that the equitable time adjustment exceeds total float in the activity or path of activities affected at the time approval was issued for the change.
- D. Use of float suppression techniques such as preferential sequences, special lead/lag logic restraints, extended activity times, or imposed dates, other than as required by the Contract, shall be cause for rejection of the Construction Progress Schedule and any revisions or updates.

3.10 PRELIMINARY CONSTRUCTION PROGRESS SCHEDULE

- A. The preliminary Construction Progress Schedule, defining the Contractor's planned operations for the first 120 calendar days shall be submitted for approval within 30 calendar days after Notice to Proceed is issued. The approved preliminary schedule shall be used for payment purposes and the basis for measuring Contractor progress not to exceed 120 days after Notice to Proceed is issued.
 - 1. Paper copies shall be provided in color on minimum 11 inch by 17 inch paper.
- B. Schedule Review and Comments
 - 1. Comments made by the A/E on the Construction Progress Schedule during review shall not relieve the Contractors from compliance with the requirements of the Contract Documents.
 - 2. Following the Contractor's receipt of the A/E's review comments, the Contractors shall correct the schedule to identify missing activities and relationships relevant to the Scope of Work. No time extensions will be granted to complete activities not initially included in the Contractor's Construction Progress Schedule.
 - 3. To the extent that there are any conflicts between the approved Construction Progress Schedule and the requirements of the Contract Documents, the Contract Documents shall govern.
- C. Resubmittal of Construction Progress Schedule
 - 1. Should the A/E reject the Construction Progress Schedule, the Schedule Manager shall comply with the A/E's direction and resubmit the Construction Progress Schedule and all associated submittals within 7 calendar days.

3.11 APPROVED CONSTRUCTION PROGRESS SCHEDULE

- A. The Construction Progress Schedule approved by the Contractors shall be submitted for acceptance within 90 calendar days after the Notice to Proceed is issued. It shall provide a reasonable sequence of activities which represent work through the entire project and a reasonable level of detail.
 - 1. Paper copies shall be provided in color on minimum 11 inch by 17 inch paper.
- B. The approved Construction Progress Schedule shall show the sequence and interdependence of activities required for complete performance of the work, beginning with Contractor's receipt of the Notice to Proceed and concluding with the date of Final Completion of the Contract. The Construction Progress Schedule shall show all activities in workdays, with allowance for holidays and the effects of normal weather conditions on outside work.
- C. The approved Construction Progress Schedule shall comply with all limits imposed by the Scope of Work, with all contractually specified intermediate milestones and completion dates, and with all constraints, restraints, or sequences included in the Contract.
- D. The Construction Progress Schedule network (graphic presentations) and computer tabulations, the Resource Loading curve and the Contractor's signatures shall be submitted to the A/E for acceptance. Additionally, the Schedule Manager shall submit two copies of the data, containing the resource loaded Construction Progress Schedule.
- E. The following computer generated reports in hard copy shall be required as part of the Preliminary and Approved Construction Progress Schedule submittals:
 - 1. Activity ID Report
 - 2. Total Float/Early Start Report
 - 3. Logic Report

4. Resource Report
 5. Coding Dictionary
 - F. The schedule network (graphic presentation) shall include:
 1. Activity ID
 2. Activity Description
 3. Original Durations
 4. Remaining Durations
 5. Early Start and Finish Dates
 6. Baseline Start and Finish Dates
 7. Total Float
 8. Percent Complete
 - G. The schedule shall be sorted by Early Start and Total Float and shall show both the Early and Target Schedule.
 - H. The Owner shall accept or reject, in writing, the Construction Progress Schedule and the associated submittals. If the Construction Progress Schedule is rejected, the Owner shall provide comments in writing to the Schedule Manager stating the reasons why the submission was not accepted.
- 3.12 Periodic Schedule Updates
- A. The following computer generated reports in hard copy and on computer diskettes shall be required as a part of the monthly update thereof as a condition precedent to the receipt of progress payments under the Contract.
 - B. The Contractor's monthly narrative report is to include:
 1. Activities started in the month (with actual start dates).
 2. Activities completed during the month (with actual start and completion dates).
 3. Activities in progress (with estimated remaining durations).
 4. Activities scheduled to start in the next month (with estimated start dates).
 5. A list of approved logic changes.
 6. A list of proposed logic changes, new activities, and deleted activities.
 7. Recommendations for adjusting the Construction Progress Schedule to meet milestone completion and Contract completion dates (include why the schedule needs adjusted, e.g., change order, weather, contractor resources, etc.).
 - a. Construction Contract Adjustment for Unexpected Adverse Weather
 - 1) Contract adjustment is justified when the number of actual adverse weather work days exceeds the expected number of adverse weather work days over the life of the project.
 - 2) The number of actual adverse weather work days and related construction task(s) are to be reported on a monthly basis at the last Progress Meeting of the month as a condition of Payment Application approval.
 - 3) The A/E is to verify with documentation the actual adverse weather work days reported by each Contractor.

- 4) The calculation of the difference between the actual adverse working weather days and expected adverse weather working days is to be reported at the first Progress Meeting of the month by the A/E.
 8. Attach copies of the Contractors' weekly schedule reports.
 - C. The Contractors graphic presentation of the schedule is to include:
 1. Activity ID.
 2. Activity Description.
 3. Original Durations.
 4. Remaining Durations.
 5. Early Start and Finish Dates.
 6. Baseline Start and Finish Dates.
 7. Total Float.
 8. Percent Complete.
 9. The schedule shall be sorted by Early Start and Total Float and should show both the early schedule and the target schedule.
 - D. Electronic data supporting the update shall be provided.
 - E. Computer generated reports are to include:
 1. Activity ID Report.
 2. Total Float/Early Start Report.
 3. Logic Report.
 4. In Progress or Planned to Start Report.
 5. In Progress or Planned to Finish Report.
 6. Resource Report.
- 3.13 TWO-WEEK LOOK AHEAD SCHEDULE SUBMISSION
- A. The Schedule Manager shall provide a two-week Look Ahead Schedule for review at the Progress Meeting that occurs closest to the 15th of each month. The Look Ahead Schedule will be based on the most recent monthly update and will show only those activities that are scheduled to begin or are in progress during the week before and for two weeks after the 15th of the current month. The two-week Look Ahead Schedule reports will contain the following information for each activity and will be required from the Contractor throughout the duration of the project unless directed otherwise by the A/E.
 1. Activity I.D.
 2. Activity Description
 3. Original Duration
 4. Remaining Duration
 5. Early Start Date
 6. Early Finish Date
 7. Percent Complete
 8. Total Float

9. Bar Graph Presentation

3.14 STANDARD ACTIVITY CODING DICTIONARY

- A. The Schedule Manager shall submit, with the Construction Progress Schedule, a coding scheme that shall be used throughout the project for all activity codes contained in the schedule. The coding scheme submitted shall list the values for each activity code category and translate those values into project specific designations. For example, A Responsibility Code Value, "ELE", may be identified as "Electrical Subcontractor". Activity code values shall represent the same information throughout the duration of the contract. Once approved with the Preliminary (first 90 calendar day) Project Schedule Submission, changes to the activity coding scheme shall be approved by the A/E.

3.15 DATA

- A. The preliminary, approved, and update Construction Progress Schedules shall be provided in the form of electronic files.
- B. File Medium:
 - 1. Submit data on media acceptable to the Contracting Authority.
- C. Disk Label:
 - 1. The Schedule Manager shall affix a permanent exterior label to each disk submitted. The label shall indicate the type of schedule (preliminary, target, update or change), full contract number, project name, project location, data date, name and telephone number of person responsible for the schedule, and file name.
- D. File Name:
 - 1. The Schedule Manager shall insure that each file submitted has a name related to the schedule data date, project name, or contract number. The Schedule Manager shall develop a naming convention that will insure that the names of all the files submitted are unique. The Schedule Manager shall submit the file naming convention to the A/E.
- E. OAKS Capital Improvements
 - 1. If the Project is administered using OAKS CI, the Construction Progress Schedule and associated data shall be submitted to the A/E through the Schedule Approvals business process.

3.16 APPROVED CHANGES VERIFICATION

- A. Only Construction Progress Schedule changes that have been previously approved by the A/E shall be included in the schedule submission. The narrative report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.
- B. The Contractor shall prosecute the work in accordance with the approved Construction Progress Schedule. Out of sequence construction, defined as a change from the Construction Progress Schedule in the Contractor's actual operation requires prior approval from the A/E.
- C. Upon the approval of a change order or the issuance of a unilateral change order by the Contracting Authority the agreed upon change order activities, activity durations, logic and impacts shall be reflected in the next schedule submittal by the Schedule Manager.
- D. No change to the approved activities, original activity durations, logic, interdependencies, milestones, planned sequence of operations, or resource loading of the Construction Progress Schedule shall be made without prior approval from the A/E. If the Contractor desires to make a change to the approved Construction Progress Schedule, the Contractor shall request permission from the A/E in writing, stating the reasons for the change as well as the specifics, such as the proposed changes in activities, original activity durations, logic,

interdependencies, milestones, planned sequence of operations, or resource loading of the baseline Construction Progress Schedule. The A/E shall respond within 14 calendar days after the receipt of the Contractor's request.

- E. If the A/E considers the Construction Progress Schedule change requested by the Contractor to be a major change, it may require the Contractor to revise and submit for approval, without additional cost to the Owner, all of the affected portions of the network diagrams, and any schedule reports, or construction equipment reports deemed necessary to show the probable effect on the entire project. The proposed network revision and required reports shall be submitted to the A/E within seven calendar days after the A/E notifies the Contractor that the requested revision is a major change. Only upon the approval of the requested change by the A/E may it be reflected in the next Construction Progress Schedule update submitted by the Contractor.
- F. A change will be considered of a major nature if the time estimated for an activity or sequence of activities is varied from the original plan to the degree that there is reasonable doubt that the Contract Completion date or milestones will be met, or if the change impacts the work of other Contractors at the job site. Changes to activities having adequate float may be considered as minor changes, except that an accumulation of minor changes may be considered a major change when such changes affect the Contract Completion date or milestones.

3.17 SCHEDULE REPORTS

- A. The format of each activity for the schedule reports listed below shall contain:
 - 1. Activity ID Number(s).
 - 2. Activity Description.
 - 3. Original Duration.
 - 4. Remaining Duration.
 - 5. Early Start Date.
 - 6. Early Finish Date.
 - 7. Baseline Start Date.
 - 8. Baseline Finish Date.
 - 9. Total Float.
 - 10. Actual Start and Actual Finish dates shall be printed for those activities in progress or completed.
- B. Activity ID Report: A list of all activities sorted according to Activity ID number and then sorted according to Early Start Date. For completed activities the Actual Start Date shall be used as the secondary sort.
- C. Logic Report: A list of preceding and succeeding activities for every activity in ascending order by activity number and then sorted according to Early Start Date. For completed activities the Actual Start Date shall be used as the secondary sort.
- D. Total Float Report: A list of all activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates.

3.18 NETWORK DIAGRAM (GRAPHIC PRESENTATION)

- A. The network diagram is required on the preliminary, baseline and monthly schedule submissions. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The A/E will use, but is not limited to, the following conditions to review compliance with this paragraph:

1. Continuous Flow: Diagrams shall show a continuous flow from left to right. The Activity ID, description, original duration, remaining duration, early start and finish dates, target start and finish dates, total float and percent completed shall be shown on the diagram.
2. Project Milestone Dates: Dates shall be shown on the diagram from start of any project, any contract required interim completion dates, and contract completion dates.
3. Critical Path(s): The Critical Path(s) shall be clearly shown.
4. Banding: Activities shall be grouped to assist in the clear understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for submittals required for performance of the Work which consist of the following: Contractor's Construction Schedule, schedule of values, product list, shop drawings, product data, samples, manufacturer's instructions and manufacturer's certificates.
- B. Related Sections:
 - 1. Document 00 72 23 – General Conditions: Article 6.18 Action Submittals
 - 2. Refer to other Division 01 sections and other Contract Documents for specifications on administrative, non-work-related submittals. Such submittals include, but are not limited to the following items:
 - a. Contractors Construction Schedule
 - b. List of Subcontractors.
 - c. Schedule of Values
 - d. Schedule of Materials and Equipment
 - e. Certificate of Insurance and Worker's Compensation Certificate.
 - f. Application for payment.
 - g. Permits.
 - h. Inspection certificates and test reports.
 - i. Items required to be submitted prior to final payment and release of retainage.
 - 3. Section 01 77 19 – Closeout Requirements: Requirements for closeout submittals.

1.02 DEFINITIONS

- A. Action Submittals: Written and graphic information that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "Action Submittals."
- B. Informational Submittals: Written and graphic information that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "Informational Submittals."
- C. Field samples: Full-size physical examples erected on-site to illustrate finishes, coatings, or finish materials. Field samples are used to establish the standard by which the Work will be judged.
- D. Mock-ups: Full-size assemblies for review of construction, coordination, testing, or operation; they are not Samples.
- E. 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.
- F. 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.

1.03 SCHEDULE OF SUBMITTALS

- A. Scheduling: Within 21 days after receipt of Notice to Proceed, submit a proposed Schedule of Submittals to the Architect. Requirements for content of preliminary Schedule of Submittals and subsequent Submittals of the Schedule of Submittals are identical. Identify on Schedule of Submittals all submittals required in the Contract Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Clearly indicate submittals that are on the Project's critical path. Indicate the following for each Submittal:

1. Indicate on the schedule the dates on which the Contractor shall furnish to the Architect the submittals required by each of the various Specification sections.
 2. Date by which Architect's response is required. Allow not less than 14 days for Architect's review, starting on Architect's actual receipt of each submittal. The actual time necessary for the Architect's review will vary according to the nature, complexity, and quality of each submittal. Allow time in the schedule for resubmittal, in accordance with the days noted above, of items which may be unacceptable. Allow increased time for large or complex Submittals and submittals which require review by several disciplines.
 3. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow 21 days for initial review of each submittal.
 4. For submittals for materials or equipment, date by which material or equipment must be at the project site to avoid delaying the Work and to avoid delaying the work of others (if any).
 5. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- B. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules in Section 01 32 16 - Construction Progress Schedule.
1. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate Submittals on the Project's critical path, or that places extraordinary demands on Architect for time and resources, is unacceptable. Do not include submittals not required by the Contract Documents.

1.04 ELECTRONIC SUBMITTAL PROCEDURES

- A. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Transmittal Form for Electronic Submittals: Use electronic form provided by the Architect.
- B. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 2. If established for the project, post electronic submittals as PDF electronic files directly to Architect's FTP site. Notify Architect in email when submittals are posted to the FTP site.
 3. All submittals are to be submitted electronically except for samples, color charts, and small mockups.

1.05 GENERAL SUBMITTAL PROCEDURES

- A. Coordinate preparation and processing of submittals with performance of construction activities. To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for resubmittals. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
- B. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity. Shop drawing and product data submittals are not required for specific products named in the specification as "Basis of Design" products or "Approved products" unless specifically required in a specifications section.
- C. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination. The Architect will withhold action on a submittal requiring coordination with other submittals until all related submittals are received. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.
- D. Prepare each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the Architect using the established transmittal form. The Architect will not accept submittals received from sources other than the Contractor.

- E. Each submittal shall include (1) electronic Submittal Cover Sheet. The Submittal Cover Sheet does not replace the required use of transmittals. The Architect will furnish each Contractor an electronic file of the required Submittal Cover Sheet. All submittals including product data and certifications, color charts, shop drawings, samples, and mock-ups each require a Submittal Cover Sheet.
1. The following will be included on the Submittal Cover Sheet provided by the Architect: Contractor's name and Project title, the Contractor's and Architect's submittal stamps.
 2. Electronically enter the following on the Submittal Cover Sheet.
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Architect's project number
 - e. Submittal Number. Submittals are to be numbered consecutively. The Architect will provide numbering instruction at the time the electronic file is forwarded to the contractor. If re-submittals are necessary, the original submittal number is used along with the suffix R1, R2, etc.
 - f. Name of Contractor/ Subcontractor/ Supplier
 - g. Name of firm or entity that prepared submittal.
 - h. Category and type of submittal.
 - i. Specification Section number and title.
 - j. Specification section, article and paragraph reference; Drawing reference number and detail references, as appropriate.
 - k. Item(s) Submitted. Provide specific information. (Example: Product data for all plumbing fixtures with the exception of fixture supports).
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Indication of full or partial submittal.
 - n. Additional Information or Proposed Deviation: The Contractor is required to specifically identify a proposed deviation contained in a submittal. (Example: Scheduled product is discontinued. Product submitted is the current model #.)
 - o. Other necessary identification.
- F. Additional requirements for submittals are:
1. The Contractors markings on the submittals shall be made in the color green. This does not apply to information on the cover sheet.
 2. Submittals that are marked by the Architect as "Not Approved" or "revise and Resubmit" will be returned to the Contractor. Revise and resubmit submittals as required; identify all changes made since previous submittal.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
 4. In addition to the above, clearly indicate the following:
 - a. Relation to adjacent structure or materials.
 - b. Field dimensions, clearly identified as such.
 - c. Product or material conformance with applicable standards, such as ASTM standard or Federal Specification.
 5. Give 5 working days' notice to Architect for delivery of shop drawings.
 6. Allow fifteen (15) working days for review by the Architect. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
- G. Transmit under a separate cover sheet each material, product, equipment or assembly required in a specification section. Submittals grouping two or more types of unrelated systems or assemblies or submittals from more than a single specification section will not be reviewed and will be returned to the Contractor. Sequentially number the transmittal forms. Re-submittals to have original number with an alphabetic suffix.
- H. Apply Contractor's stamp, signed or initialed, certifying that review, verification of products required, field dimensions, adjacent construction Work, and coordination of information are in accordance with the requirements of the Contract Documents.
- I. Schedule submittals to expedite the Project and deliver to Architect at business address. Coordinate submission of related items.

- J. 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 Architect's action stamp.
- K. 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.
- L. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.06 SUBMITTAL TYPES

- A. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- B. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- C. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- D. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- E. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- F. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. 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.
- G. Preconstruction Test Reports: Submit 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 in the Contract Documents.
- H. Field Test Reports: Submit reports 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 in the Contract Documents.
- I. Maintenance Data: Comply with requirements specified.

1.07 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule as part of the bid submittal. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Owner additional time for handling and reviewing submittals required by those corrections. Coordinate dates of submittal with Architect. Architect will comment on multiple submittals occurring at the same time. Make revisions per Architect's comments.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 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 information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's and Owner's final release or approval.
 - g. Scheduled date of fabrication.
 - h. Scheduled dates for purchasing.
 - i. Scheduled dates for installation.
 - j. Activity or event number.
- B. Submittal Format: Submit a sample transmittal and template for each submittal type with standardized cover sheet for approval as part of the bid submittal.

1.08 INFORMATIONAL SUBMITTTALS

- A. General: Prepare and submit Informational Submittals required by individual Specification Sections.
- B. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 16 – Construction Progress Schedule.
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- D. Certificates:
 - 1. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 - 2. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 - 3. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 - 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- E. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 45 00 – Quality Requirements.
- F. Reports:
 - 1. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
 - 2. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. 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.
 - 3. 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.

4. Preconstruction Test Reports: Submit 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 in the Contract Documents.
 5. Compatibility Test Reports: Submit 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.
 6. Field Test Reports: Submit written reports 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 in the Contract Documents.
 7. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions 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.
- G. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 – Project Coordination.
- H. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 19 – Closeout Requirements.

1.09 PROPOSED PRODUCT SCHEDULE

- A. Within 10 days after execution of the Agreement, submit schedule of major products proposed for use. Prepare schedule in tabular form showing each product proposed for use in the Work. Include the manufacturer's name and proprietary product names for each item listed.
1. Coordinate the product list with the list of proposed materials manufacturers.
 2. Prepare the product schedule with information on each item tabulated under the following column headings:
 - a. Related specifications section number.
 - b. Generic name used in Contract Documents.
 - c. Proprietary name, model number and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 3. Provide a written explanation for omissions of data and for known variations from Contract requirements.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation and reference standards.
- C. Submit proposed Product Schedule in PDF electronic file format.

1.10 PRODUCT DATA

- A. Collect product data 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. Where product data must be specially prepared because standard printed data is not suitable for use, submit as "shop drawings". Do not submit product data until compliance with requirements of the Contract Documents has been confirmed. Do not submit product data with Manufacturer Safety Data Sheets (MSDS). If included, these documents will be passed through without examination by the Architect.
- B. Mark each page of submittal to show which products and options are applicable. Where printed product data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information as applicable:
1. Manufacturer's catalog cuts
 2. Manufacturer's product specifications
 3. Standard color charts

4. Statement of compliance with specified referenced standards.
 5. Testing by recognized testing agency.
 6. Application of testing agency labels and seals.
 7. Availability and delivery time information.
 8. 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.
- C. Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the work.
1. The data shall be supported by sufficient descriptive material, such as catalog cuts, diagrams, and other data published by the manufacturer, as well as by evidence of compliance with performance standards, to demonstrate conformance to the Specification requirements.
 2. Catalog numbers alone are not acceptable.
 3. The data shall include, but shall not be limited to, the name and address of the nearest service and maintenance organization that regularly stocks repair parts. No consideration shall be given to partial lists submitted unless otherwise noted.
 4. Review of materials and equipment is tentative, subject to submission of complete shop drawings indicating compliance with the Contract Documents.
 5. Cross out information which is not applicable to the work.
 6. Supplement standard information to provide additional information which is applicable to the work.
 7. Show dimensions and clearances required.
 8. Show performance characteristics and capacities.
- D. Do not proceed with installation until a copy of product data is in the Installer's possession.
- E. Submit Product Data before or concurrent with Samples.
- F. Submit Product Data in PDF electronic file format.

1.11 SHOP DRAWINGS

- A. 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. For drawings requiring large details, full-size hardcopy drawings, 24 inches by 36 inches or larger must be submitted in addition to a PDF electronic file.
- B. Shop drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:
1. Identification of products and materials included by sheet and detail number.
 2. Dimensions.
 3. Compliance with specified standards.
 4. Notation of coordination requirements.
 5. Notation of dimensions established by field measurement.
 6. Relationship and attachment to adjoining construction clearly indicated.
 7. Seal and signature of professional engineer if specified.
- C. Coordination drawings are a special type of shop drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.
1. Preparation of coordination drawings is specified in Section 01 31 00 – Project Coordination, and may include components previously shown in detail on shop drawings or product data.
- D. After review, reproduce and distribute in accordance with "Submittal Procedures" above, and for record documents described in Section 01 77 19 – Closeout Requirements.
- E. Submit shop drawings in PDF electronic file format.

1.12 SAMPLES

- A. Submit the required number of physical samples required, the Architect will retain a minimum of two (2) physical Samples, remainder will be returned unless otherwise provided. Cure and finish samples as specified and physically identical with the material or product proposed.
- B. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
- C. Mount, display, or package samples in the manner to facilitate review of quantities indicated. Prepare samples to match the Architect's sample. Include the following information attached with label on unexposed side of Samples and include the following:
 - 1. Generic description of the sample.
 - 2. Specification section number and paragraph number reference.
 - 3. Sample source.
 - 4. Product name or name of manufacturer.
 - 5. Compliance with recognized standards.
 - 6. Availability and delivery time.
- D. Submit the required number of physical samples required, the Architect will retain a minimum of two (2) physical Samples, remainder will be returned unless otherwise provided. Cure and finish samples as specified and physically identical with the material or product proposed.
- E. Samples may include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing colors, texture and pattern. Illustrate functional and aesthetic characteristics of materials, equipment, or workmanship, with integral parts and attachment devices. Coordinate sample submittals for interfacing Work.
- F. Where variation in color, pattern, texture or other characteristic is inherent in the material or product represented, submit at least 3 multiple units that show approximate limits of the variations.
- G. Refer to other Specification sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.
- H. Reviewed samples which may be used in the Work are indicated in individual specification sections.
- I. Disposition: Maintain sets 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.
- J. Furnish additional certification of conformance to the specification requirements as may be requested by the Architect.

1.13 QUALITY ASSURANCE SUBMITTALS

- A. Submit quality control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals under other sections of the specifications.
- B. Where other sections of the Specifications require certification that a product, materials, or installation complies with specified requirements, submit a notarized certifications from the manufacturer certifying compliance with specified requirements.
 - 1. Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.
- C. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 – Project Coordination.
- D. Contractor's Construction Schedule: Comply with requirements specified in this section.
- E. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 45 00 – Quality Requirements.
- F. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 19 – Closeout Requirements.

- G. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- H. Certificates:
 - 1. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 - 2. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 - 3. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 - 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- I. Reports:
 - 1. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
 - 2. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. 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.
 - 3. 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.
 - 4. Preconstruction Test Reports: Submit 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 in the Contract Documents.
 - 5. Compatibility Test Reports: Submit 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.
 - 6. Field Test Reports: Submit written reports 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 in the Contract Documents.
 - 7. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions 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.

1.14 DELEGATED-DESIGN SERVICES SUBMITTALS

- A. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions 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.
- B. 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 Architect.
- C. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file and paper copy of certificate, 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.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 CONTRACTOR RESPONSIBILITIES

- A. Submittals of shop drawings, product literature or data, samples, etc., shall be made for complete assemblies or units of the Work. Submittals which represent only a portion of a part of a larger assembly or unit of work is not acceptable and will be rejected by the Architect.
- B. Check shop drawings, project data and samples prior to submission. Shop drawings not indicating evidence of checking by Contractor will be returned without review by the Architect. No time extensions will be permitted for this type of resubmittal.
- C. All submittals must bear a stamp indicating that the Contractor has reviewed the submittal prior to forwarding to the Architect, or they will be returned to the Contractor without action.
- D. Coordinate each submittal with requirements of the Work and of Contract Documents.
- E. Contractor is not relieved of responsibility for errors or omissions in shop drawings, product data, samples or similar submittals by Architect's approval thereof.
- F. Contractor is not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of shop drawings, product data, samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and the Architect has given written approval to the specific deviation.
- G. Notify Architect, in writing at time of submission, of deviations in submittals from requirements of Contract Documents.
- H. Begin no work which requires submittals until return of submittals with Architect's stamp and initials or signature indicating review.
- I. Materials or equipment installed prior to the required shop drawing, product data, or sample approval shall be subject to removal and replacement by the Contractor at no additional cost to the Owner, if in the opinion of the Architect, such materials or equipment do not meet the requirements of the Contract Documents.
- J. No xerographic or altered xerographic reproductions of the Contract Documents are permitted as submittals. Facsimiles or copies of facsimiles are not acceptable as required submittals to be furnished under this section.

3.02 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 1. Approved
 2. Approved as Noted
 3. Revise and Resubmit.
 4. Submit Additional Information

5. Rejected
 6. Not Required for Review
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- D. Review of submittals is not for the purpose of determining the accuracy or completeness of details, dimensions, or quantities, or for substantiating instructions for installation or performance of equipment or systems.
- E. Architect's review is not for approval of safety precautions or of construction means, methods, techniques, sequences, or procedures.
- F. Approval of a specific item shall not indicate approval of an assembly of which the item is a component.
- G. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- H. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- I. Submittals not required by the Contract Documents will be returned or discarded by the Architect without action.

3.03 AFFIXING REVIEW STAMP

- A. Separate Line Items: Affix an image of the Review Stamp to each separately-reviewable item of the submittal package. For example:
1. On each separate Shop Drawing sheet, affix a Review Stamp image.
 2. For each separate item appearing on a Contract Document schedule, affix a separate Review Stamp image. For example: lighting fixture; plumbing fixture.
 3. For each separate type of a product identified for the specified item, affix a separate Review Stamp image. For example, glass type; masonry unit type; metal panel type.
- B. When affixed, the Review Stamp shall not obscure information contained in the submittal.
- C. Fill in name of Contractor and Contractor's project or contract number, if not already entered on stamp.
- D. In the section of the stamp titled "Contractor Action," fill in the following information:
1. Section number of the Specification Section for which the submittal is being made, and Paragraph number of specific submittal requirement within the Section. Do not include items from more than one Specification Section on one form.
 2. Submittal number: Refer to Submittal Form Instructions for submittal numbering.
 3. Item number as shown on the Submittal Form.
 4. Date submitted by Contractor.
 5. Mark to signify whether item is Shop Drawing, Product Data, or Sample, or, if 'Other,' enter descriptive words on the blank line.
 6. Signature of authorized representative of the Contractor who has performed the Contractor's review and approval of the submittal item, and the date.

END OF SECTION



ARCHITECTURE. INSPIRED.

COMPUTER FILE RELEASE APPLICATION & ELECTRONIC RECORD DRAWINGS AGREEMENT

COMPANY NAME & ADDRESS: [COMPANY NAME]

[Date]

[Address]

[Phone]

APPLICANT NAME / TITLE:

[Name / Title]

[Email Address]

PROJECT:

[Project Name & No. (If Appl.)]

Schooley Caldwell will release the computer files to the Contractor. At completion of work, the Contractor agrees to submit As-Built / Record Drawings to Schooley Caldwell in AutoCAD/REVIT® electronic file formats and one set of marked-up Record Prints. The following file formats will not be accepted as AutoCAD .dwg files: .tif, .jpg, .jpeg, or .pdf.

[LIST FILES HERE]

Upon receipt by Schooley Caldwell of this approved application, Schooley Caldwell will produce electronic files containing the Architectural "Base" file including walls, doors, and windows, but excluding notes, dimensions, borders, and engineering content. These files are to provide a background for contractors and **are not** exact copies of the bid set or any other set.

Any use or reuse of the original or altered files by the Applicant or others will be at the Applicant's sole risk and full legal responsibility. Furthermore, the Applicant will, to the fullest extent permitted by law, indemnify and hold Schooley Caldwell harmless from any and all claims, suits, liability, demands or costs arising out of or resulting there from.

REQUESTED BY:

Contractor Signature

DATE:

Authorization for use of Schooley Caldwell computer files must be approved in writing by Schooley Caldwell. Unauthorized use or copying of Schooley Caldwell computer files is not permitted.

SCHOOLEY CALDWELL AUTHORIZATION:

APPROVED BY:

Signature

DATE:

c: [Names or delete this line if no one copied]

300 Marconi Boulevard
Columbus, Ohio 43215

T 614 628.0300

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schooleycaldwell.com

SECTION 01 42 00
REFERENCE STANDARDS AND DEFINITIONS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes general definitions for Specifications and other Contract Documents. Basic contract definitions are included in the "Contracting Definitions" document.
- B. Comply with standards in effect as of date of the Contract Documents except comply with standards having different revision dates as referenced in the codes as indicated on Drawings.
- C. Related Sections:
 - 1. Drawings and general provisions of Contract, including General Conditions and Division 01 Specification sections, apply to Work of this section.
 - 2. Document 00 71 00 – Contracting Definitions

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

1.03 GENERAL DEFINITIONS

- A. General Explanation: Basic Contract definitions are included in the Construction Agreement of the Contract. Certain terms used in Contract Documents are defined generally in this article. Definitions and explanations that follow are not necessarily either complete or exclusive, but are general for the Work to the extent they are not stated more explicitly in other provisions of the Contract Documents.
- B. Approved: The term "approved" where used in conjunction with Architect's action on the Contractor's submittals, requests, and applications, is limited to the Architect's duties and responsibilities as specified in the Conditions of the Contract. In no case will "approval" by Architect be interpreted as a release of Contractor from responsibilities to fulfill requirements of Contract Documents.
- C. Cutting and Patching: The term "cutting and patching" means cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.
 - 1. Cutting and patching is performed for coordination of the Work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.
 - 2. Cutting and patching performed during the manufacturer 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."
- D. Demolish: Section 02 41 19.
- E. Directed, Requested, etc.: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by Architect" "requested by Architect" and similar phrases. However, no such implied meaning shall be interpreted to extend Architect's responsibility to Contractor's area of construction supervision.
- F. "Existing to Remain" or "Retain": Section 02 41 19.
- G. Indicated: The term "Indicated" is a cross-reference to graphic representations, notes, or schedules on the Drawings or other paragraphs or Schedules in the Specifications, and to similar requirements in Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.

- H. Installer/Applicator/Erector: Contractor or an entity (person or firm) engaged by the Contractor, either as an employee, subcontractor or contractor of lower tier, to perform a particular construction activity, including installation, application or erection and similar required operations. Installers are required to be experienced in the operations they are engaged to perform.
1. Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.
- I. Project Site: The project site is the space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing either work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land upon which the Project is to be built.
- J. Protect: The term "protect" shall mean to cover, enclose, shield or take other designated measures to avoid damage or harm. Items protected will either remain in place, or will be salvaged for re-installation in the Work. The type of protection shall be as specified. Where the type of protection is not specified, items shall be protected from any and all damage, scratches, marking, overspray, dripping, deterioration, or movement from any and all activities scheduled to take place on this Project, and/or would be typical to a Project site such as this one.
- K. Re-install: The term "re-install" or "re-installation" shall mean to install a salvaged or stored item or material in the Work.
- L. Remove: Section 02 41 19
- M. Repair:
1. The term "repair" shall be defined as "Replacement of component(s), either damaged or missing, which are part of a larger assembly, to return an existing material as closely as possible to its original form, structural integrity and condition." Generally, the types of work required to achieve a "repaired" condition are the following:
 - a. Disassembly of existing components or construction for the purpose of installing new components.
 - b. Removal of the component or portion of an assembly designated for repair.
 - c. Preparation of the adjacent surfaces to receive the repair.
 - d. Installation and securing the repaired component in the assembly.
 - e. Preparation of the assembly to receive a finish as specified in the finishing or painting specification.
- N. Replace:
1. The term "replace" shall be defined as providing in a former position of place.
 2. The term may be combined with such terms as "with existing" or "with new" which define exactly what is to be replaced.
 3. Refer to individual specification sections for further definition of "replace" as it relates to a specific application or condition.
- O. Restore:
1. The term "restore" shall be defined as a general term for the process of returning a material, component, system or portion of work as nearly as possible to its original form or condition when it was new.
 2. The term "restore" when used in a general sense may include the process of 'repair' defined above.
 3. Refer to individual specification sections for further definition of "restore" as it relates to a specific application or condition.
 4. Generally, the process involved with "restore" or "restoration" include the following:
 - a. Removal of applied items or materials which are not to be part of the restored work.
 - b. Stripping or other types of removal of surface applied coatings (i.e., paint).
 - c. Modifying the material if it is required to accommodate new work.

- d. Replacement of portions of components or materials that cannot be restored because of condition, including those that are deteriorated or otherwise damaged. Replacement is typically done with dutchmen.
 - e. Reinforcing broken components when this procedure is acceptable in lieu of "repair."
 - f. Tightening and securing open or loose joints.
 - g. Patching or plugging holes or other severe loss of the existing material.
 - h. Filling of minor holes, scratches, dents, or other deformation not associated with normal wear and tear.
 - i. Sanding of the repaired surfaces smooth as a result of the restore process, prior to final surface preparation for finishing.
- 5. Minor surface preparation of a reconditioned surface prior to other finishing or painting is not considered part of the "restore" process, and is specified as preparation in the finishing or painting specification.
- 6. It is not the intent of the "restore" process to return a material that shows normal wear to an original "like new" appearance or condition. Rather, such wear is considered a normal part of the use and life of the particular material, and as such does not require "restoring"
- P. Regulation: The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- Q. Store: The term "store" shall mean to protect and place in a designated area. Where an area is not designated, the Contractor responsible for the item shall provide adequate and reasonable facilities acceptable to the Architect.
- R. Testing Agencies: A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.04 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.
 - 1. Referenced standards (referenced directly in Contract Documents or by governing regulations) have precedence over non-referenced standards which are recognized in industry for applicability to Work.
 - 2. Publication Dates: Comply with standard in effect as of the date of the Contract Documents, unless otherwise indicated.
 - 3. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed to perform a required construction activity, obtain copies directly from the publication source.
 - 4. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authority having jurisdiction, or other entity applicable to the content of the text provision.
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1.05 GOVERNING REGULATIONS AND AUTHORITIES

- A. The Architect has contacted authorities having jurisdiction where necessary to obtain information to prepare Contract Documents. Contact authorities having jurisdiction directly for information and decisions regarding the Work.

- B. For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts of fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01 45 00
QUALITY REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for Contractor's quality control and testing and inspection services and administrative and procedural requirements for Special Inspection and testing by third party testing agency.
- B. Quality control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by the Architect.
- C. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-control requirements for individual construction activities are specified in the 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 Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- D. Related Sections:
 - 1. Drawings and general provisions of Contract, including General Conditions and Division 01 Specification sections, apply to Work of this section.
 - 2. Refer to other Division 01 sections and other Contract Documents for specifications on administrative, non-work related submittals. Such submittals include, but are not limited to the following items:
 - a. General Conditions: (Testing and Inspection Services).

1.02 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- D. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- F. 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 the standard by which the Work will be judged.

- G. Special Inspection: Inspection by a testing agency, as required by the International Building Code Chapter 1704, of materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and reference standards.
- H. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- I. Testing Agency: Section 01 42 00.

1.03 ACTION SUBMITTALS

- A. Schedule of Tests and Inspections: Prepare and submit a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Include Contractor performed tests and those of sub-contractors. Include testing by third party engaged by the Architect. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the 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 the 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 the 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. Ambient conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
 - 14. Highlight non-conforming test results.
- 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 the Work.

1.04 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 1. Specification Section number and title.
 2. Entity responsible for performing tests and inspections.
 3. Description of test and inspection.
 4. Identification of applicable standards.
 5. Identification of test and inspection methods.
 6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.
- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, 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 the Work.

1.05 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities:
 1. Contractor to provide Q/C plan to demonstrate controls for quality in accordance with the following:
 - a. Q/C management plan.
 - b. Qualifications of Q/C supervisor(s) and organizational chart for chain of command.
 - c. Sample daily Q/C reports and checklists.
 - d. Q/C methods for storage and handling.
 - e. Q/C methods for selective demolition
 - f. Q/C methods for testing and inspection.
 - g. Q/C methods for installation of new materials.
 - h. Q/C methods for testing and reporting to the Owner.
- C. 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.
- D. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- E. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 2. Special inspections required by authorities having jurisdiction
 3. Owner-performed tests and inspections indicated in the Contract Documents.
- F. 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.

- G. 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.

1.06 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. 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. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- D. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- E. 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.
- F. 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.
- G. Specialists: Certain sections of the 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 the activities indicated.
 - 1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.
- H. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- I. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.
- J. Comply fully with manufacturer's instructions, including each step in sequence. Installation shall be carried out in a manner to reduce damage to or waste of materials by needed replacement. Should manufacturer's instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- K. Comply with specified standards as a minimum quality for Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- L. Perform work by persons qualified to produce workmanship of specified quality.
- M. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.
- N. Verify that field measurements are as indicated on construction and/or shop drawings before confirming product orders or proceeding with work, in order to minimize waste due to excessive materials.
- O. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Coordinate the work of multiple subcontractors as needed to build complete mockups of multi-component systems.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Perform field tests on mock-up panels to show compliance with requirements as specified in individual sections.
6. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Demolish and remove mockups when directed, unless otherwise indicated.

1.07 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 1. Owner will furnish Contractor 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 the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Contractor shall provide quality-control services specified and required by authorities having jurisdiction for their work.
 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 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 Contractor's responsibility, submit a certified written report, in triplicate, of each quality-control service to the Architect, and Owner.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Price will be adjusted by Change Order.
- D. Special Tests and Inspections: Per General Conditions ¶3.3.1, A/E shall apply for, secure, and pay for the costs of structural testing and special inspections under Chapter 17 of the Ohio Building Code. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
 1. Testing agency will notify Architect, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Architect, with copy to Contractor and to authorities having jurisdiction.
 3. Testing agency will submit a final report of special tests and inspections at Project Completion, which includes a list of unresolved deficiencies.
 4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Testing agency will retest and reinspect corrected work.
- E. 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.

- F. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.
- G. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 3. Submit a certified written report, in triplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
 - 5. Do not perform any duties of Contractor.
- H. Architects 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 the following:
 - 1. Access to the Work.
 - 2. Incidental labor, materials, 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. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- I. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-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.

1.08 SPECIAL

1.09 REFERENCES

- A. Conform to reference standard by date specified in product sections, or if not indicated, the date of issue current on date of Contract Documents.
- B. Obtain copies of standards when required by Contract Documents.
- C. For products or workmanship specified by reference to association, trade, or industry standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- D. Should specified reference standards conflict with Contract Documents, request clarification for Architect before proceeding.
- E. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.10 CONTRACTORS OTHER TESTING AND INSPECTION SERVICES

- A. The Owner shall employ and pay for services of an independent commercial testing and inspection agency to perform professional consultation, inspections, tests, and other services indicated in individual specification sections.
- B. Testing and Inspection Agency Responsibilities:
 - 1. Provide competent technicians experienced in review and inspection of portion of work under review.

2. Perform specified inspections, samplings, and testing of materials and methods of construction in compliance with requirements of governing authorities and with specified standards.
 - a. Comply with standards other recognized authorities, and as specified in individual Specification Sections of this Project Manual.
 - b. Ascertain compliance of materials with requirements of Contract Documents.
 3. Testing agency shall:
 - a. Receive material samples, mix designs, etc. delivered to laboratory and perform testing.
 - b. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - c. Provide field testing equipment and items needed to measure and test.
 - d. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - e. Should certain testing or space criteria be needed provide timely notification to Contractor prior to start of the test activity.
 - f. Perform additional tests and/or inspections as needed.
 4. Testing agency personnel are not authorized to:
 - a. Revoke, alter, enlarge on, or release requirements of Contract Documents
 - b. Approve or accept any portion of Work
 - c. Perform duties of Contractor
 - d. Direct or stop work
 5. Submit one copy each of report to Owner, contractors, Architect, and consultants as applicable within 3 days following tests. Distribution shall be as follows:
 - a. Owner: 1 copy
 - b. Contractor: 1 copy
 - c. Architect: 1 copy
 6. Notify Architect, and Contractor of observed irregularities or non-conforming work or products not later than 2 hours following observation.
 7. Testing agency personnel shall attend progress meetings and coordination meetings when their presence is needed.
- C. Contractor Responsibilities:
1. Cooperate fully with testing agency personnel; furnish samples of materials, design mix, equipment, storage and assistance as requested.
 2. Notify testing agency sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests, but in no case shall notification be less than one-week.
 3. Secure and deliver to testing agency adequate quantities of representative samples of materials proposed to be used that require testing.
 4. Provide to testing agency preliminary design mix proposed to be used for concrete, and other materials mixes that require control.
 5. Furnish copies of product tests or mill test reports as required.
 6. Furnish incidental labor and facilities:
 - a. To provide access to work to be tested
 - b. To obtain and handle samples on-site or at source of product to be tested
 - c. To facilitate inspections and tests
 - d. For storage and curing of test samples
 7. Make arrangements with testing agency and pay for additional samples and tests for Contractor's convenience.

1.11 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 Architect.
- B. Delegated-Design Services Statement: Submit a statement 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, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.12 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.13 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, testing, and adjustment as applicable, and to initiate instructions when necessary.
- B. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Submit report in duplicate within 30 days of observation to Architect for review.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.
 1. Submit log at Project closeout as part of Project Record Documents.

3.02 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 Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.
 2. Comply with the Contract Document requirements for Section 01 73 29 – Cutting and Patching.
- B. Protect construction exposed by or for quality-control service activities.

- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 45 33
SPECIAL INSPECTIONS AND PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section defines responsibilities and requirements for **Special Inspections and Tests** as mandated by the Ohio Building Code (OBC), Chapter 17, Section 1705.
- B. Related Documents:
 - 1. Schedule of Special Inspections on drawings.
- C. Work includes:
 - 1. Preparation of Statement of Special Inspections.
 - 2. Engagement of qualified Special Inspectors and Testing Agencies.
 - 3. Performance of inspections and testing during construction.
 - 4. Submittal of interim and final reports to the Building Official.
- D. The A/E will apply for, secure, and pay for the costs of third party special inspections under Chapter 17 of the Ohio Building Code; including the Special Inspections and testing listed in "Schedule Of Required Special Inspections & Tests."
- E. Tests and inspections shall be performed in accordance with noted OBC requirements, specific referenced standards, or in the absence thereof, applicable industry standards approved by authorities having jurisdiction. These tests and inspections are in addition to and separate from other quality assurance testing.
- F. The Contractor shall coordinate the testing and inspection agency's work with the overall construction schedule to ensure sufficient notification of testing agency, and allow proper completion of required testing and inspections.
- G. Third Party Testing and Inspection Agency: An established and recognized agency regularly engaged in conducting tests and/or furnishing inspection services, when such agency has been approved in accordance with the rules of the Ohio Board of Building Standards, and hired by the Contractor.
- H. Special testing and inspections provided under this Section do not negate or supersede testing and inspection requirements contained within individual material Sections, or those required by legal authorities having jurisdiction over the entire scope of the Work.
 - 1. Refer to Division 02 through 49 Sections for testing and inspections provided under that Section.
 - 2. Refer to local regulations regarding type and frequency of inspections required by authorities having jurisdiction.
 - 3. Refer to individual sections and Section 01 45 00 – Quality Requirements for additional information.

1.02 DEFINITIONS

- A. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.
 - 1. Independent: An approved agency shall be objective and competent. The agency shall also disclose possible conflicts of interest so that objectivity can be confirmed.
 - 2. Equipment: An approved agency shall have adequate equipment to perform required tests. The equipment shall be periodically calibrated.
 - 3. Personnel: An approved agency shall employ experienced personnel educated in conducting, supervising and evaluating tests and/or inspections.
- B. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

- C. Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.
- D. Quality-Assurance Services: Activities, actions and procedures performed before and during execution of the work to guard against defects and deficiencies and ensures that proposed construction complies with requirements.

1.03 ACTION SUBMITTALS

- A. Testing and Inspection Agency: Owner/Architect will submit to the Contractor the testing and inspection agency's name, contact person, address, phone number and other pertinent data he may request to allow the Contractor to properly coordinate his work with the testing and inspection agency's work.
- B. Testing and Inspection Schedule: Prepare and submit to Owner, Architect and agency a proposed schedule of testing and inspection dates for the various portions of the Work. Submit updated schedules each month.
- C. Testing and Inspection Agency Reports: Agency shall submit reports in accordance with the requirements of OBC §1704.2.4 and the following:
 - 1. One (1) copy to the Building Official (plans examiner).
 - 2. One (1) copy to the Owner, Architect and Contractor.
 - 3. One (1) copy of Final report to the Building Official (plans examiner), Owner, Architect and Contractor.
 - 4. One copy of all reports contained in a 3-ring binder to the Owner at the completion of the Project.

PART 2 – PRODUCTS

2.01 TESTING AND INSPECTION REPORTS

- A. Regular Reports: Prepare separate reports on each item noted in Part 1.01 paragraph A above.
 - 1. Reports to state work inspected or tested was in compliance with approved Construction Documents (Drawings and Specifications), or contains noted discrepancies.
- B. Final Report: Prepare final reports on each item inspected or tested. Include correction of discrepancies and other pertinent data.
- C. Reports Binder: Assemble all reports into a heavy-duty, 3-ring, vinyl-covered, loose- leaf binders, in thickness necessary to accommodate contents, sized to hold 8½" x 11" paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 1. Organization: Organize each manual into separate sections for each item inspected or tested. Within each section, place reports in chronological order. Provide a title page and table of contents.
 - 2. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 - a. Date of submittal.
 - b. Subject matter included in manual.
 - c. Name and address of Project.
 - d. Name and address of Owner.
 - e. Name and address of Agency.
 - f. Name, address, and telephone number of Contractor.
 - g. Name, address, and telephone number of Installer for each product and system inspected or tested.
 - h. Name and address of Architect.
 - 3. Identify binder on front and spine, with printed title "TESTING AND INSPECTION MANUAL," Project title or name, and subject matter of contents.

PART 3 – EXECUTION

3.01 EXECUTION

- A. Testing and inspection agency to perform testing and inspections required by the Ohio Building Code (OBC) Chapter 17, Section 1705 "Special Inspection" for the following portions of the Work.
- B. Testing and inspection agency to perform testing and inspections required by the Ohio Building Code (OBC) Chapter 17, Section 1705 "Required Special Inspections and Tests," for the following portions of the Work.

3.02 SCHEDULE OF REQUIRED SPECIAL INSPECTIONS & TESTS

Note: Reference structural drawing sheet for summary of Special Inspection and Testing requirements.

<u>OBC Reference</u>	<u>Category</u>	<u>Test Frequency</u>
1705.2	Steel Construction	Schedule of Special Inspections on Drawing Sheet S003A
1705.3	Concrete	Schedule of Special Inspections on Drawing Sheet S003A
1705.4	Masonry	Schedule of Special Inspections on Drawing Sheet S003A
1705.5	Wood Construction	Schedule of Special Inspections on Drawing Sheet S003A
1705.6	Soils	Schedule of Special Inspections on Drawing Sheet S003A
1705.12	Seismic Resistance	Schedule of Special Inspections on Drawing Sheet S003A

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes requirements for construction facilities and temporary controls, including temporary utilities, support facilities, and security and protection.
- B. Related Sections include the following:
 - 1. Drawings and general provisions of the Contract, including General Conditions and Division 01 specification sections, apply to work of this section.
- C. Related Documents:
 - 1. Document 00 72 13 – General Conditions of the Contract for Construction (General Contracting Project)
 - 2. Section 01 11 00 – Summary of Work: General requirements and description of project and procedures.

1.02 DEFINITIONS

- A. "Maintain" shall mean to keep in service and operation; and to provide such repairs as required to keep in continued service and safe, sound condition until and only if directed by the Architect to be removed.

1.03 USE CHARGES

- A. Refer to General Conditions for use charge responsibilities.

1.04 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction.
 - 1. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, 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.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- 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 work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste handling procedures.
 - 5. Other dust-control measures.

1.05 DESCRIPTION OF REQUIREMENTS

- A. Provide all materials, labor and related items necessary to complete the Work indicated on the drawings and specified.
- B. Specific administrative and procedural minimum actions are specified in this section, as extensions of provisions in General Conditions and other Contract Documents. These requirements have been included for special purposes as indicated. Nothing in this section is intended to limit types and amounts of temporary Work required, and no omission from this section will be recognized as an indication by Architect that such temporary activity is not required for successful completion of the Work and compliance with requirements of Contract Documents.
- C. Provisions of this section are applicable to, but not by way of limitation, utility services, construction facilities, security/protection provisions and support facilities.
- D. Provide and maintain temporary construction facilities and control as specified herein and as required for the progress and completion of the Work. Terminate and remove when no longer required for proper performance of the Work, or when permanent facilities are available for use.
- E. Provide, maintain, and protect temporary construction facilities and controls as specified herein in a manner which does not interfere with the permanent construction; which is safe, non-hazardous, sanitary, and which adequately protects the public, workmen, and the Work.
- F. Provide materials and equipment adequate in capacity for the intended use, which will not create unsafe conditions, and that conform to applicable codes and standards.
- G. Contractors requiring one of the temporary services or controls before it can be provided shall provide such service as suits Contractor's needs at Contractor's own expense.
- H. Comply with industry standards and applicable laws and regulation of authorities having jurisdiction including, but not limited to, the following:
 - 1. Building code requirements.
 - 2. Environmental protection regulations.
 - 3. Health and safety regulations.
 - 4. Utility company regulations.
 - 5. Police and fire department rules.
- I. Comply with the following standards:
 - 1. NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations."
 - 2. ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and ANSI A10.6, NECA's "Temporary Electrical Facilities."
 - 3. Comply with NEMA, NECA, and UL standards and regulation for temporary electrical service. Install service in compliance with NFPA 70 "National Electrical Code."
- J. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 - 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
- K. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- L. Install, operate, maintain and protect temporary facilities in a manner and a location which will be safe, non-hazardous, sanitary and protective of persons and property and free of deleterious effects.
- M. Protect work against damage and maintain work, materials, apparatus and fixtures free from injury or damage in accordance with the General Conditions during the entire construction period. Protect installed work and provide special protection where specified in individual specification sections. Work likely to be damaged shall be covered or protected at the end of each day's work. Work damaged by failure to provide protection required, shall be removed and replaced with new work at the Contractor's expense.
- N. Provide for the security of the existing building during periods when work is not being performed, and at times when the building is exposed to the exterior. Coordinate access barrier locations within the existing buildings which can be secured with a lock to prohibit access during these periods.

- O. Protect existing finished floors, stairs, and other wearing surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials as specified in this section and as noted on the drawings.

1.06 PROJECT CONDITIONS

- A. 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.
 - 3. Temporary facilities and controls shall be removed by the designated Contractor responsible for the temporary facility and/or controls upon completion of the work, unless otherwise indicated.
- B. Prepare a schedule indication dates for implementation and termination of each temporary facility. Establish and initiate use of each temporary facility at time first reasonably required for proper performance of the Work. Terminate use and remove facilities at earliest reasonable time, when no longer needed or when permanent facilities have, with authorized use, replaced the need.
- C. Operate temporary facilities in a safe and efficient manner. 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.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Provide new materials; if acceptable to Architect, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for use intended.
- B. Lumber and Plywood: Comply with requirements in Section 06 10 00 – Rough Carpentry.
- C. Paint: Comply with requirements of Section 09 91 00 – Painting.
 - 1. For sign panels and applied graphics, provide exterior-grade alkyd gloss enamel over exterior primer.
 - 2. For temporary enclosures, safety barriers and similar uses of exposure to weather, provide exterior-grade plywood painted with acrylic-latex emulsion over exterior primer. Color to be provided by Architect.

2.02 EQUIPMENT

- A. Provide new equipment; if acceptable to Architect, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.
- B. First Aid Supplies: Comply with governing regulations.
- C. 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 241 for classification, extinguishing agent and size required by location and class of fire exposure.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

- A. 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.

- B. Provide each facility ready for use when 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.
- C. Remove each temporary facility when the need has ended, when replaced by authorized use of permanent facility, or no later than Substantial Completion. Complete, or if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

3.02 TEMPORARY WATER FOR CONSTRUCTION USE

- A. Water is available at the existing building. Connect to Owner's existing water service facilities.
- B. Furnish the necessary hoses, nozzles, connectors, accessories and temporary extensions to properly service his own requirement, and Contractors shall be held responsible for damage resulting from his careless use of water.

3.03 TEMPORARY POWER & LIGHTING

- A. Electric service is available at the site.
- B. Furnish the necessary extension cords for temporary electric and lighting to properly service the Contractor's requirements. Contractors shall be responsible for the proper use and maintenance of their cord sets and cord-and-plug connected equipment. Do not fasten to stone or decorative floor or wall finishes.
- C. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, and inspections.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- D. Complete all work in conformance with requirements of the National Electric Code, OSHA, and the Authority Having Jurisdiction.

3.04 TEMPORARY SANITARY FACILITIES, INCLUDING DRINKING WATER

- A. Sanitary facilities include 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.
- B. Provide temporary portable self-contained chemical type toilets, acceptable to public health authorities, quantity equal to one toilet for each 25 men/women on project. Computation of men/women present includes men/women of each Contractor, and Architect's and Owner's personnel. Shield toilets to ensure privacy. Locate temporary toilets where directed.
 - 1. Provide toilet tissue, paper towels, and similar disposal materials for each facility. Provide covered waste containers for used materials.
 - 2. Maintain temporary toilets in an antiseptic condition until completion of Work. Clean toilets a minimum of once a week or more often if required. Installation shall be provided in a manner acceptable to Owner, Architect, and governing Board of Health.

3.05 TEMPORARY ENCLOSURES

- A. Temporary Enclosures: 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 openings.
 - 1. Provide necessary measures to protect temporary and final work, existing building, material and equipment from weather damage. This includes ground water, rainwater, wind, ice, snow and the backing up of sewers and drains.
 - 2. Provide temporary insulated weather tight closures of all openings in exterior walls and roofs.
 - a. Provide this protection. Where existing building is conditioned with heating or cooling, provide insulated temporary enclosures in openings.

- b. In existing construction, provide temporary enclosures for exterior windows that are to be restored or replaced.
- 3. Maintain existing roof drains and protect areas of partial demolition until area is enclosed and weather tight.
- 4. Maintain existing site drainage, exterior catch basins and areaway drains within construction site so water does not pond.
- 5. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
- 6. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.

3.06 PROTECTION OF WORK AND PROPERTY

- A. Protect the work and existing or adjacent property against weather, to maintain the work, materials, apparatus and fixtures free from injury or damage in accordance with the General Conditions during the entire construction period. Work likely to be damaged shall be covered or protected at the end of each day's work. Work damaged by failure to provide protection required, shall be removed and replace with new work at the Contractor's expense.
- B. Protect the work in progress in accordance with the provisions of this article and the provisions of individual specification sections.
 - 1. Protect stored and installed material from flowing or standing water.
 - 2. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 3. Do not load or install gypsum board or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 4. Keep interior spaces reasonably clean and protected from water damage.
 - 5. Periodically collect and remove waste containing cellulose or other organic matter.
 - 6. Do not install material that is wet.
 - 7. Discard or replace water-damaged material.
 - 8. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- C. 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 precautions to prevent injury or damage to individuals or property.
- D. 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 by the Contractor.
 - 2. When utility lines and structures that are to be removed or relocated are encountered within the area of operations, notify the Contractor and affected utility in ample time for the necessary measures to be taken to prevent interruption of the services.
 - 3. Damage to existing utility lines or structures not indicated or known shall be reported immediately to the General Contractor and the affected utility.

3.07 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Security: The Owner will maintain responsibility for building security. Comply with Owner's required security requirements while performing the Work.
- B. Barricades: Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic, barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.
- C. Temporary Enclosures: 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.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

3.08 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Partially Exposed 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. 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.
 - 6. Do not load or install gypsum board or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 7. Keep interior spaces reasonably clean and protected from water damage.
 - 8. Periodically collect and remove waste containing cellulose or other organic matter.
 - 9. Do not install material that is wet.
 - 10. Discard or replace water-damaged material.
 - 11. Discard, replace, or clean stored or installed material that begins to grow mold.
 - 12. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- C. 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 permanent HVAC system to control humidity.
 - 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 readings beginning at time of exposure and continuing daily for 48 hours. 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.

3.09 DEWATERING FACILITIES

- A. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Extract and dispose of groundwater and rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.

3.10 ON-SITE STORAGE

- 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.
- B. Provide suitable weathertight storage sheds of sufficient size to hold materials required on the site at one time, for storage of materials which might be damaged by the weather. Storage area on the site will be designated.
- C. Coordinate available space; under no circumstances will any materials be stored outside of the construction limits.

3.11 TEMPORARY FIRE PROTECTION

- A. Take all necessary precautions to guard against and eliminate all possible fire hazards and to prevent damage to any construction work, building materials, equipment, temporary field offices, storage sheds, and all other property, both public and private. The emergency number of the local fire department shall be conspicuously posted in field offices. Take precaution to prevent fire hazards in accordance with all fire protection regulations and codes, including the following:
1. Prohibit smoking on construction site.
 2. **FIRE EXTINGUISHERS:** Provide and maintain in working order, at all times during construction, fire extinguishers conveniently located for proper protection. Personnel working on the Project shall be familiarized with the locations and operation of fire extinguishers.
 3. Store combustible materials in containers in fire safe locations.
 4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for fighting fires.
 5. In case of fire, notify the fire department immediately. Contractor's workmen shall assist in extinguishing the fire until firefighting personnel arrives.
 6. Perform no welding, flame cutting or other operations involving the use of flame, arcs or sparking devices without adequate protection and shielding. Remove all combustible and flammable materials from the immediate working area. If removal is impossible, protect all flammable or combustible materials. Provide the necessary personnel and firefighting equipment to effectively control any fire resulting from welding, flame cutting or other operations involving the use of flame, arcs or sparking devices.
 7. For all flammable liquids having a flash point of 110 degrees F. or below, use Underwriter's Laboratories' labeled safety cans. Store the bulk supply of all flammable liquid at least 75 feet from the building and yard storage of building materials. Spigots on drums containing flammable liquids are prohibited on the project site. Drums shall be equipped with approved vent pumps.
 8. Use only fire resistant tarpaulins.
 9. Develop and supervise an overall fire-prevention and first aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 10. Provide fire watch for all open flame activities.

3.12 PROTECTION OF THE PUBLIC

- A. All necessary precautions to prevent injury to the public or damage to property of others shall be taken.
- B. When necessary to maintain public use of work areas involving vehicular roadways, etc., protect the public in accordance with the applicable regulations;
- C. When necessary to maintain public use of work areas involving sidewalks, entrances to buildings, lobbies, corridors, aisles, stairways, vehicular roadways, etc., protect the public in accordance with all applicable laws and regulations;
- D. Sidewalks, entrances to buildings, lobbies, corridors, aisles, doors or exits shall be kept clear of obstructions, holes, materials, water intrusion and other conditions to permit safe ingress and egress of the public at all times;
- E. Appropriate warnings, signs and instructional safety signs shall be conspicuously posted where necessary;
- F. Required signs and symbols shall be visible at all times when work is being performed and shall be removed or covered promptly when the hazards no longer exist;

3.13 TEMPORARY CONSTRUCTION BARRIERS, FENCES, AND STAIRS

- A. Prior to the start of construction, provide temporary construction fences, barricades, etc. to separate construction activities from the public for safety and liability protection. Location of safety fencing may vary from time to time as construction progress and need dictates. Comply with standards and code requirements for erecting structurally adequate barricades. Provide appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.

- B. Provide and maintain fences, barricades, etc., for adequate protection of persons, street trees, landscaping and adjoining property from damage, harm or exposure due to his work. Remove protective devices when work is complete or when authorized by the Architect.
- C. Provide an 8'-0" minimum high heavily woven chain link construction fence with gates to separate construction staging and storage areas from the public for safety and liability protection. Fencing must be freestanding on standards without any attachment to pavement or paving materials. Sand bags are an acceptable anchorage for this fencing.
 - 1. Three strands of barbed wire shall be added to the top of fence and angled outward from job site unless special circumstances prevent it, solely at the direction of the Facilities Design and Construction's Project Manager, in consultation with the Director of Projects. Exceptions must be in writing and documented in the project files.
 - 2. Gates: Provide swing gate assembly for access enclosed storage areas.
 - a. Except during working hours, gates shall be kept locked by the General Contractor at all times.
 - b. One gate shall be double locked with a Owner security padlock and the contractor's padlock in a manner that will allow access by unlocking either padlock. Other prime contractors may install their own padlocks if it is determined that they will require access to the area at time other than regular working hours. The Owner security padlock shall be obtained from, and returned to, the Owner Project Manager.

3.14 ROOFING PROTECTION

- A. Provide protection for roof area(s) that will be affected by the project. Protection shall consist of using ½-inch thick plywood with foam board attached. The composite board shall be laid with the foam towards the roof surface and shall be arranged to protect the roof from falling objects, i.e., hand tools, power hand tools and material. The protective covering shall be secured in a non-destructive fashion (i.e. weighted down) to avoid dislocation in inclement weather. This protection shall not relieve the Contractor from responsibility to repair any damage to the roof resulting from the work.
- B. At all time that roofing work is in progress, provide such protection measures to assure that the roofing system remains watertight.

3.15 PROTECTION OF INSTALLED CONSTRUCTION

- A. Protect the work and existing or adjacent property against weather and maintain work, materials, apparatus, and fixtures free from injury or damage during the construction period. Cover or protect work at the end of each day's work. Remove work damaged by failure to provide protection and provide new work meeting project requirements at Contractor's expense.
 - 1. Remove snow and ice as required for proper protection and execution of the work and protection and safety of the public.
 - 2. Provide winter weather closures at hoist openings, tops of stairwells, and temporary doors at enclosed openings.
 - 3. Maintain temporary water pumps to keep building basement areas and pits clear of water accumulations at all times.
- B. Refer to "Temporary Construction Barriers" for requirements of tarpaulins.

3.16 DEBRIS REMOVAL

- A. Daily cleanup of the Contractor's debris is mandatory for this project and is to be included in the Contract. Contractor is responsible to properly transport general debris to the dumpster or trash container locations and compaction of debris into said containers in a manner that allows containers to be fully utilized. Materials not removed by the Contractor or improperly stored, will be discarded, as directed by the Architect, at the delinquent Contractor's expense, including replacement of material, if required.
- B. Materials not removed by the Contractor or improperly stored, will be discarded, as directed by the Architect, at the delinquent Contractor's expense, including replacement of material, if required.

3.17 DUMPSTERS

- A. Provide dumpsters as required to service the project. Contractors failing to load dumpsters properly and/or failing to break down cartons, ductwork, etc. will be charged for removal of partially filled dumpsters. Schedule all dumpster deliveries and pickups. The site will allow a construction trailer and dumpster located as directed by the Owner.
- B. Daily cleanup of the Contractor's debris is mandatory for this project and is to be included in the Contract. Contractor is responsible to properly transport general debris to the dumpster or trash container locations and compaction of debris into said containers in a manner that allows containers to be fully utilized. Materials not removed by the Contractor or improperly stored, will be discarded, as directed by the Architect, at the delinquent Contractor's expense, including replacement of material, if required.
- C. Only normal construction debris may be discarded in the dumpsters. Any hazardous materials shall be removed from the project by the Contractor creating or responsible for the debris.
- D. No burning of trash or debris is allowed.

3.18 CONSTRUCTION AIDS

- A. Architect's Access to the Work: Facilitate access to the worksites for the Architect and Owner's representative examination of all portions of the Work while in progress, and during closeout phase of the work. The Architect will communicate the dates of site visits near the completion of the work.
- B. Provide temporary hoists, chutes, scaffold and scaffold towers, swing stages, planking, ladders, and similar items necessary for proper and efficient movement of materials, and operating personnel as required for the performance of the Work by all trades. Such apparatus and equipment shall meet requirements of labor laws, federal safety regulations, and other applicable codes, laws, and regulations of authorities having jurisdiction.

3.19 PROJECT SIGNAGE

- A. Provide safety signage to facilitate the Contractor's work.
- B. 'No Trespassing' signs, which meet OSHA requirements, are required.

3.20 JOBSITE MAINTENANCE

- A. Comply with all governing traffic control regulations. Clean streets, sidewalks, paved areas, etc., during progress of the work.
- B. Cleaning:
 - 1. Keep the premises free at all times from all waste materials, packaging materials and other rubbish accumulated in connection with the execution of the work by collecting and depositing said materials and rubbish in locations or containers as designated.
 - 2. Clean and remove from own work soiling, staining, mortar, concrete or dirt caused by the execution of the work and make good additional defects resulting there from.
 - 3. At the completion of portions of the Work and the entire completion of Project, remove all tools, equipment, scaffolds, shanties, and surplus materials. Execute all required final cleaning.
- C. Depositing rubbish, scrap materials, debris, etc., in dumpsters (in a specified location). Absolutely no burning of debris or trash will be allowed.
- D. Environmental Protection: Provide protection, operate temporary facilities, and conduct cleaning and repair in ways and by methods that comply with environmental regulations, and minimize the possibility that the building interior, building air handling and HVAC systems, external atmospheric air, waterways, and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment that produce harmful noise.

3.21 TEMPORARY ACCESS AND PARKING

- A. Refer to notes on drawing for description of contractors use of parking spaces and Section 01 11 00 – Summary of Work, Article "Contractors' Use of Premises."
- B. Traffic Controls: The Contractor to comply with requirements of authorities having jurisdiction.

1. Contractor shall assign a workman to assist construction vehicles arriving and departing the construction site and to monitor and protect vehicular and pedestrian traffic.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

3.22 OPERATION, TERMINATION, AND REMOVAL

- A. Enforce strict discipline in use of temporary facilities. Maintain facilities in good operating condition until removal. Materials and facilities that constitute temporary facilities are property of Contractor.
- B. Maintain operation of temporary enclosures and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. 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.

END OF SECTION

SECTION 01 56 39
TREE AND PLANT PROTECTION

PART 1 – GENERAL

1.01 SUMMARY

- A. The scope of work includes all labor, materials, tools, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with protection of existing trees and other plants as shown on the drawings and as specified herein.
 - 1. Provide temporary tree and plant protection fencing.
 - 2. Provide protection of root zones and above ground trees and plants.
 - 3. Removal of tree protection fencing and other protection from around and under trees and plants.
 - 4. Clean up and disposal of all excess and surplus material.

1.02 CONTRACT DOCUMENTS

- A. It is the intent of this section that the requirements apply to all sections of the project specification such that any subcontractor must comply with the restrictions on work within designated Tree and Plant Protection Areas.

1.03 REFERENCES

- A. References: The following specifications and standards of the organizations and documents listed form a part of the specification to the extent required by the references thereto. If the requirements of the following referenced standards and specification conflict with this specification section the requirements of this specification shall prevail. If the requirements of any of the following referenced standards and specifications conflict with each other the more stringent requirement shall prevail.
 - 1. ANSI A 300 (Part 5) – Standard Practices for Tree, Shrub and other Woody Plant Maintenance, most current editions.
 - 2. Pruning practices shall conform with recommendations “Structural Pruning: A Guide for The Green Industry”; Published by Urban Tree Foundation, Visalia, California; most current edition.
 - 3. Glossary of Arboricultural Terms, International Society of Arboriculture, Champaign IL, most current edition.

1.04 PERMITS AND REGULATIONS

- A. The Contractor shall obtain and pay for all permits related to this section of the work unless previously excluded under provision of the contract or general conditions. The Contractor shall comply with all laws and ordinances relating to the operation or conduct of the work as drawn and specified. If the Contractor observes that a conflict exists between permit requirements and the work outlined in the contract documents, the Contractor shall promptly notify the Owner’s Representative in writing including a description of any necessary changes and changes to the contract price resulting from changes in the work.
- B. Wherever references are made to standards or codes in accordance with which work is to be performed or tested, the edition or revision of the standards and codes current on the effective date of this contract shall apply, unless expressly set forth.
- C. In case of conflict among any referenced standards or codes or between any referenced standards and codes and the specifications, the more restrictive standard shall apply.

1.05 DEFINITION

- A. All terms in this specification shall be as defined in the “Glossary of Arboricultural Terms” or as modified below.
- B. Owner’s Representative: The person appointed by the Owner to represent their interest in the review and approval of the work and to serve as the contracting authority with the Contractor. The Owner’s Representative may appoint other people to review and approve any aspects of the work.

- C. Reasonable and reasonably: When used in this specification is intended to mean that the conditions cited will not affect the establishment or long-term stability, health, or growth of the plant. This specification recognizes that plants are not free of defects, and that plant conditions change with time. This specification also recognizes that some decisions cannot be totally based on measured findings and that professional judgment is required. In cases of differing opinions, the Owner's Representative expert shall determine when conditions within the plant are judged as reasonable.
- D. Shrub: Woody plants with mature height approximately less than 25 feet.
- E. Tree and Plant Protection Area: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and defined by a circle centered on the trunk with each tree with a radius equal to the crown dripline unless otherwise indicated by the owner's representative.
- F. Tree: Single and multi-stemmed plants, including palms with anticipated mature height approximately greater than 25 feet or any plant identified on the plans as a tree.

1.06 SUBMITTALS

- A. Product Data: Submit manufacturer product data and literature describing all products required by this section to the Owner's Representative for approval. Provide submittals four weeks before the start of any work at the site.

1.07 OBSERVATION OF THE WORK

- A. The Owner's Representative may inspect the work at any time.

1.08 PRE-CONSTRUCTION CONFERENCE

- A. Schedule a pre-construction meeting with the Owner's Representative for at least seven (7) days before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.
 - 1. The following Contractors shall attend the preconstruction conference:
 - a. General Contractor.
 - b. Subcontractor assigned to install Tree and Plant Protection measures.
 - c. Earthwork Contractor.
 - d. All site utility Contractors that may be required to dig or trench into the soil.
- B. Prior to this meeting, mark all trees and plants to remain and or be removed as described in this specification for review and approval by the Owner's Representative.

1.09 QUALITY ASSURANCE

- A. Contractor qualifications:
 - 1. All applications of pesticide or herbicide shall be performed by a person maintaining a current state license to apply chemical pesticides valid in the jurisdiction of the project. Submit copies of all required state licensing certificates including applicable chemical applicator licenses.

PART 2 – PRODUCTS

2.01 TREE PROTECTION FENCING

- A. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft.; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi.
 - 1. Height: 48 inches.
 - 2. Color: High-visibility orange, nonfading.
 - 3. Post: 6 ft. T-shape galvanized-steel post driven into the ground of sufficient depth to hold the fabric solidly in place without sagging.
 - a. Spacing: As indicated on the drawings.

- b. Wire Ties: Galv. or Stainless Steel, min. 16-18 gauge wire, 3 per post.
- B. Submit suppliers product data that product meets the requirements for approval.

PART 3 – EXECUTION

3.01 SITE EXAMINATION

- A. Examine the site, tree, plant, and soil conditions. Notify the Owner's Representative in writing of any conditions that may impact the successful Tree and Plant Protections that is the intent of this section.

3.02 TREE AND PLANT PROTECTION AREA

- A. The Tree and Plant Protection Area is defined as all areas indicated on the tree protection plan. Where no limit of the Tree and Plant Protection area is defined on the drawings, the limit shall be the drip line (outer edge of the branch crown) of each tree.

3.03 PREPARATION

- A. Prior to the preconstruction meeting, layout the limits of the Tree and Plant Protection Area and then alignments of required Tree and Plant Protection Fencing and root pruning. Obtain the Owner's Representative's approval of the limits of the protection area and the alignment of all fencing and root pruning.
- B. Flag all trees and shrubs to be removed by wrapping orange plastic ribbon around the trunk and obtain the Owner's Representative's approval of all trees and shrubs to be removed prior to the start of tree and shrub removal. After approval, mark all trees and shrubs to be removed with orange paint in a band completely around the base of the tree or shrub 4.5 feet above the ground.
- C. Flag all trees and shrubs to remain with white plastic ribbon tied completely around the trunk or each tree and on a prominent branch for each shrub. Obtain the Owner's Representative's approval of all trees and shrubs to be remain prior to the start of tree and shrub removal.
- D. Prior to any construction activity at the site including utility work, grading, storage of materials, or installation of temporary construction facilities, install all tree protection fencing, and tree protection signs, as shown on the drawings.

3.04 PROTECTION OF EXISTING PLANTS TO REMAIN

- A. The contractor and all subcontractors and employees working on site shall be aware of the following information:
 - 1. Most of a tree's roots are located in the upper few inches of topsoil. For this reason, trees are vulnerable to immediate and long-term damage. Immediate damage to roots is caused by grading, use of vehicles and tools, and excess pedestrian traffic above the roots. Long-term damage is caused by the compaction of the soil above the roots by use of vehicles, storage of materials, and excess pedestrian traffic.
 - 2. Protection of a tree therefore includes the protection of the roots of the tree as well as its trunk, branches, and leaves. Roots are best protected by fencing off as large an area as possible around each tree, so that no driving, parking, walking, or storage of materials takes place where it may cause damage.
 - 3. The roots of a tree often extend far into the surrounding landscape, including areas well beyond the outer perimeter of the tree's canopy. For this reason, operations should be confined to the smallest possible area.
 - 4. As a practical minimum, however, every effort is made to protect the area beneath the canopy of the tree, also known as the area inside the "drip line." This area is sometimes referred to as the "root zone."
 - 5. Soil is most vulnerable to compaction, and roots to damage, when the soil is wet.
- B. Review all fence limits with the Owner's Representative before erecting fences or beginning work.
- C. Erect the tree protection fence before selective demolition, selective tree and plant material removal and pruning or any other construction activity commences. Keep tree protection fence in place until removal is approved by the Owner's Representative.

- D. Minor adjustments to the fence layout, which are not represented on the Drawings, might be required to facilitate the work. Minor adjustments shall be made at no additional cost to the project.
- E. Erect the protective fence so that it is securely in place and resistant to ordinary seasonal climatic forces, adjacent pedestrian movement, and work operations.
- F. The Contractor shall periodically inspect, repair and maintain protective fences during the course of construction operations. During periods of construction stoppages, including but not limited to delays and over-wintering, the Contractor shall periodically inspect, repair and maintain protective fences.
- G. The Owner and Owner's Representative reserve the right to require the Contractor to provide additional or more secure tree protection devices if it is determined that the existing trees are not being properly protected by the Contractor or if the vegetation is threatened with damage through the Contractor's operations.
- H. Temporary access within plant protection areas is permitted to perform construction operations as described on the Drawings. All work within tree protection areas shall be performed by hand or with small equipment that will not damage or threaten damage to trees. All tree protection fencing shall be restored at the end of each day's operation.
- I. If the Owner's Representative determines at any time that trees are not being protected to the standards herein, he may order construction activity to stop immediately and to remain stopped until the non-compliant condition or practice is corrected. The Contractor shall comply with this provision at no additional cost to the Owner. This provision in no way affects the Contractor's obligation to complete the work of this contract by the date specified.
- J. Protect existing trees and other vegetation to remain in place. Do not burn, cut, break, skin, or bruise trunk, roots, or branches. Do not stockpile construction materials and/or excavated materials within drip line of the tree. Do not fasten ropes, cables, or guys to any existing trees unless specifically authorized by the Owner's Representative.
- K. The parking of vehicles, driving of vehicles, storage of materials, removal of soils, and stockpiling of soils within the drip line of trees, including trees located on adjacent properties which overhang the site, is expressly prohibited except as approved by the Owner's Representative, for work directly related to grading revisions as indicated on the drawings.
- L. Utilities: Route utilities away from existing trees even if shown otherwise. Review re-routing with Owner's Representative and Civil Engineer. Do not proceed without written direction. Minimize the cutting of tree roots, and when cutting is unavoidable, cut cleanly with a power saw and not an excavating machine. If cutting is required, comply with "Protection of Tree" specifications included in this Section.
- M. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
- N. Do not permit water to stand around the base of plants within the drip line during construction operations except during that period of inundating flooding which would, in its natural course, cover the base of trees. The Contractor shall provide temporary drainage where required to avoid ponding during construction operations and after the flood waters have receded below the elevation at the base of each inundated tree.
- O. Provide protection for roots over 1-1/2" diameter cut during construction operations. Roots that re encountered during the course of construction which require cutting shall be cleanly cut with a hand or power saw; cutting of roots with machinery is expressly prohibited. When roots that must be cut are encountered, all work shall cease until roots have been properly cut. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
- P. Fertilizing: After pruning operations are completed, fertilize trees to increase vigor with a complete, slow release nitrogen, phosphorus, potassium (1:1:1 or 2:1:1) liquid injected fertilizer. Where liquid injected fertilizer is not practical, and when approved by Owner's Representative, drill holes 6" to 10" deep and place granular fertilizer at frequent spacing.

3.05 CLEAN-UP

- A. During tree and plant protection work, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.

1. Immediately clean up any spilled or tracked soil, fuel, trash, or debris deposited by the Contractor from all surfaces within the project, public right of ways and neighboring property.
- B. Once tree protection work is complete, wash all soil from pavements and other structures. Ensure that Mulch is confined to planting beds.
- C. Make all repairs to grades, ruts, and damage to the work or other work at the site.
- D. Remove and dispose of all excess Mulch, Wood Chips, packaging, and other material brought to the site by the Contractor.

3.06 REMOVAL OF FENCING AND OTHER TREE / PLANT PROTECTION

- A. At the end of the construction period or when requested by the Owner's Representative remove all fencing, and any other Tree and Plant Protection material.

3.07 DAMAGE OR LOSS TO EXISTING PLANTS TO REMAIN

- A. Any trees or plants designated to remain, and which are damaged by the Contractor shall be replaced in kind by the Contractor at their own expense. Trees shall be replaced with a tree of similar species and of equal size/caliper. Shrubs shall be replaced with a plant of similar species and equal size or the largest size plants reasonably available whichever is less. Where replacement plants are to be less than the size of the plant that is damaged, the Owner's Representative shall approve the size and quality of the replacement plant.
 1. All trees and plants shall be installed per the requirements of the Planting Specification Section.
- B. Plants that are damaged shall be considered as requiring replacement or appraisal if the damage affects more than 25% of the crown, 25% of the trunk circumference, or root protection area, or the tree is damaged in such a manner that the tree could develop into a potential hazard. Trees and shrubs to be replaced shall be removed by the Contractor at his own expense.
 1. The Owner's Representative may engage an independent arborist to assess any tree or plant that appears to have been damaged to determine their health or condition.
- C. Any tree that is determined to be dead, damaged, or potentially hazardous by the Owner's arborist and upon the request of the Owner's Representative shall be immediately removed by the Contractor at no additional expense to the owner. Tree removal shall include all cleanup of all wood parts and grinding of the stump to a depth sufficient to plant the replacement tree or plant, removal of all chips from the stump site and filling the resulting hole with topsoil.
- D. Any remedial work on damaged existing plants recommended by the consulting arborist shall be completed by the Contractor at no cost to the owner. Remedial work shall include but is not limited to soil compaction remediation and vertical mulching, pruning and or cabling, insect and disease control including injections, compensatory watering, additional mulching, and could include application tree growth regulators (TGR).
- E. Remedial work may extend to two years following the completion of construction to allow for any requirements of multiple applications or the need to undertake applications at required seasons of the year.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes the following administrative and procedural requirements, selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections/Documents:
 - 1. Drawings and general provisions of Contract, including General Conditions and Division 01 Specification sections, apply to Work of this section. Such sections include, but are not limited to the following items:
 - a. Section 01 25 00 – Substitution Procedures
 - b. Section 01 33 00 – Submittal Procedures: Requirements for submittals.
 - c. Section 01 77 19 – Closeout Requirements for submitting warranties for contract closeout.

1.02 DEFINITIONS

- A. Definitions in this paragraph are not intended to change the meaning of other terms used in Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," "furnishings," "special construction," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
- B. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. "Named Products" are items identified by manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, which is current as of date of the Contract Documents.
 - 2. "New Products" Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products.
 - 3. "Comparable Product" is a product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified products.
- C. "Basis-of-Design" Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.
- D. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications. Submit a comparable product request, if applicable.

- E. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Burden of Proof: The burden of proof as to the applicability of the proposed comparable product as well as documentation sufficient for the Architect's review is the responsibility of the Contractor.
 - 3. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

1.03 ACTION SUBMITTALS

- A. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 33 00 – Submittal Procedures.
- B. Substitution: Refer to Section 01 25 00 – Substitution Procedures for definition and limitations on substitutions.
- C. Special Warranty Submittals: Submit special warranties form from manufacturer for Architect's review and approval before procuring product or services.

1.04 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. When specified products are available only from sources that do not or cannot produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect for a determination of the most important product qualities before proceeding. Qualities may include attributes relating to visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources that produce products that possess these qualities, to the fullest extent possible.
- C. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
 - 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle and store products according to the manufacturer's recommendations using methods and means that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
 - 2. Coordinated delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
 4. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.
- C. Packaging:
1. Deliver products to the Project site in their manufacturer's original container, with labels intact and legible.
 - a. Maintain package materials with seals unbroken and labels intact until time of use.
 - b. Promptly remove damaged material and unsuitable items from the project site, and promptly replace with material meeting the specified requirements at no additional cost to the Owner.
 2. The Architect may reject as non-complying such materials, equipment, and products that do not bear identification satisfactory to the Architect as to manufacturer, grade, quality, or other pertinent information.
- D. Protection:
1. Protect finished surfaces, including but not limited to jambs, soffits or openings used as passageways, through which material and material are transported.
 2. Provide protection for finished floor surfaces in traffic areas prior to allowing equipment or materials to be moved over such surfaces.
 3. Maintain finished surfaces clean, unmarred and suitably protected until accepted by the Owner.
- E. Repairs and Replacements:
1. In the event of damage, promptly make replacements and repairs to the satisfaction of the Owner and at no additional cost to the Owner.
 2. Additional time required to secure replacements and to make repairs will not be considered justification for an extension in the Contract Time of Completion.
- F. Storage:
1. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 2. Store products to allow for inspection and measurement of quantity or counting of units.
 3. Store materials in a manner that will not endanger Project structure.
 4. Store products and equipment that are subject to damage by weather, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation. Protect during procurement and until final in-place installation.
 5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 6. Protect stored products from damage and liquids from freezing.
 7. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

1.06 PRODUCT WARRANTIES

- A. 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 Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for 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 indicated form properly executed.
 3. Refer to Divisions 02 through 50. Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 19 – Closeout Requirements.

PART 2 – PRODUCTS

2.01 GENERAL PRODUCT COMPLIANCE

- A. General: The compliance requirements, for individual products as indicated in Contract Documents, are multiple in nature and may include generic, descriptive, proprietary, performance, prescriptive, compliance with standards, compliance with codes, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with.
1. Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.
 2. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
 3. Provide products which are free of asbestos and lead.
 4. Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

2.02 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," Architect will make selection.
 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Basis-of-Design Product: Where Specifications name a product or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 25 00 – Substitution Procedures for substitutions for convenience.
 2. Named Product: Where Specifications name a single product and manufacturer, provide the named product 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. Comparable products or substitutions for Contractor's convenience will not be considered.
 - b. Nonrestricted List: Where Specifications include a list of names of available products followed by "but are not limited to", provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
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 manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers followed by "but are not limited to", provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
6. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
8. Product Uniformity: It is the intent of the documents that the completed construction be uniform throughout the Project. For each type of product, the manufacturer and model shall not vary. After a particular product has been identified and approved for an application, that product shall be used for that application across all the subcontracts and other Work-related contracts held by the Contractor or Construction Manager. This provision applies equally to accepted substitutions.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, 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, Architect 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, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
 - c. Custom Color or Range: Where Specifications include the phrase "custom color, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from a palette separate from manufacturer's standard and premium items.

2.03 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
 1. Evidence that the proposed product does not require revisions to the Contract Documents, which is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Evidence that the proposed product has the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified Product "Standard":
 3. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate the proposed unnamed product.
 4. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 5. Products for finishes: Products which are substantially similar in appearance, as judged solely by the Architect.
 6. Evidence that proposed product provides specified warranty.
 7. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 8. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 33 00 – Submittal Procedures.
1. Form of Approval of Submittal: As specified in Section 01 33 00 – Submittal Procedures.
 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install, erect, connect, condition, use, adjust, and clean products in accordance with manufacturer's instructions and in conformity with specified requirements.
1. Verify and coordinate clearances, dimensions and installation of adjoining construction, equipment, piping, ducts, conduits, or other mechanical or electrical items or apparatus.
 2. Prior to fabrication, field measure actual existing conditions to ensure proper fit.
 3. Inspect each item of material or equipment immediately prior to installation. Reject damaged and defective items.
 4. Recheck measurements and dimensions of Work, as an integral step of starting each installation. Whenever stock manufactured products are specified, verify actual space requirements for setting or placing into allotted space. No extra cost will be allowed for adjustment of Work to accommodate particular product.
- B. 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 in spaces without a suspended ceiling.
- C. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- D. Install products at the time and under conditions that will ensure the best possible results in coordination with entire project. Maintain conditions required for product performance until Substantial Completion.
1. Isolate each unit of work from incompatible work as necessary to prevent deterioration.
 2. Coordinate enclosure of work with required inspections and tests to minimize necessity of uncovering work for those purposes.
- E. 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.

- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels during building occupied hours.
- 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 attachment and connection devices and methods for securing work to withstand stresses, vibration, physical distortion, disfigurement, or racking.
 - 1. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work
 - 2. Mounting Heights: Where not indicated, mount individual units of work at industry recognized standard mounting heights for particular application indicated.
 - a. Refer questionable mounting heights choices to Architect for final decision.
 - b. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.
 - 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. Secure work true to line and level, and within specified tolerances, or if not specified, industry recognized tolerances. Allow for building movement, including thermal expansion and contraction.
 - 5. Physically separate, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
- 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. Refer questionable visual-effect choices to Architect for final decision.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
- K. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components to ensure operability without damaging effects.
- L. Adjust operating products and equipment to ensure smooth and unhindered operation.

END OF SECTION

SECTION 01 73 00
EXECUTION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Installation of the Work.
 - 3. Progress cleaning.
 - 4. Starting and adjusting.
 - 5. Protection of installed construction.
 - 6. Correction of the Work.
- B. Related Sections:
 - 1. Drawings and general provisions of Contract, including General Conditions and Division 01 Specification sections, apply to Work of this section. Such sections include, but are not limited to the following items:

1.02 ACTION SUBMITTALS

- A. Provide the following submittals in conformance with Section 01 30 00 – Submittal Procedures.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 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 underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, 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. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.
- C. 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.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Existing Utility Information: Furnish information to Owner 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 caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Coordination."

3.03 INSTALLATION

- A. General: 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 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- 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 Substantial 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.
- 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. Allow for building movement, including thermal expansion and contraction.
 - 2. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 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.
- 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.

3.04 CUTTING AND PATCHING

- A. Refer to Section 01 73 29 – Cutting and Patching.

3.05 PROGRESS CLEANING

- A. Clean and protect construction in progress and adjoining materials in place during handling and installation. Apply protective covering where required to assure protection from damage or deterioration until Individual Substantial Completion dates.
- B. During the progress of the work, remove all waste materials and rubbish and deposit such waste in the project dumpster. Perform daily broom cleaning in the area of the Contractor's work. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period.
 - 1. Keep the premises free at all times from all waste materials, packaging materials and other rubbish accumulated in connection with the execution of work by collecting and depositing said materials and rubbish in locations or containers as designated by the Contractor.
 - 2. Clean and remove from own work soiling, staining, mortar, concrete or dirt caused by the execution of work and make good additional defects resulting therefrom.
 - 3. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - a. Remove liquid spills promptly.
 - b. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - 4. Absolutely no burning of debris or trash will be allowed.
 - 5. At the completion of portions of the Work and the entire completion of work, remove all tools, equipment, scaffolds, shanties, and surplus materials. Execute all required final cleaning.
- C. 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. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
 - 4. 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.
- 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. 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.
- H. 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.
- I. 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.

3.06 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 23 requirements.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 01 45 00 – Quality Requirements.

3.07 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial 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.

3.08 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes requirements and limitations for cutting, demolition, removal work, patching and restoration of work as necessary to accomplish and complete all work under the Contract, including relocation or reuse of existing materials, equipment, systems, or other work, as well as the disposition of salvaged materials or debris.
 - 1. This Section applies to all work under the Contract, including general construction, mechanical and electrical work.
- B. Related Sections:
 - 1. Drawings and general provisions of Contract, including General Conditions and Division 01 Specification sections, apply to Work of this section. Such sections include, but are not limited to the following items:
 - a. Section 01 33 00 – Submittal Procedures: Requirements for submittals.
 - b. Section 01 73 00 – Execution
 - c. Section 02 41 19 – Selective Demolition for demolition of selected portions of the building for alterations.
 - 2. Divisions 03 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - a. Requirements in this Section apply to mechanical and electrical installations. Refer to Division 20 and 30 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.02 DEFINITIONS

- A. "Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.
 - 1. "Cutting and patching" is performed for coordination of the Work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.
 - a. Cutting and patching performed during the manufacturer 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."
 - 2. "Tooththing in" – is the process of removing masonry at a specific location in the existing wall for the purpose of creating an opening in the existing wall, or to fill an existing opening by removing half-blocks such other full stretcher units can be installed to fill the opening in a toothed pattern. Follow procedures described herein.
 - 3. "Channeling" is a cutting and patching process to remove the minimum amount of finish and substrate materials necessary to "Channel" a path on the face of a surface to permit the installation of new electrical service in the work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.
- C. "Selective Demolition" is a related but separate category of work which may or may not require cutting and patching required in this section.

1.03 DESCRIPTION

- A. Drawings generally indicate the extent of demolition, removals, relocations and cutting. The drawings shall not be construed as indicating all required work, nor indicating all conditions or details which might be encountered to accomplish the work of this Contract.
 - 1. The Contractor and subcontractors must examine the existing conditions themselves to determine the actual requirements. All removals, demolition, cutting, restoration, new installations and other work shall be accomplished to transform the existing conditions to the new conditions required under the Contract, as well as to accomplish all tie-in work of new to existing.

1.04 INFORMATIONAL SUBMITTALS

- A. Procedural Proposal for Cutting and Patching: Prior approval of cutting and patching is required for work which is not identified or inferred from the Contract Documents; therefore, submit proposed procedures for this work well in advance of the time work will be performed and request approval to proceed. Include the following information, as applicable, in the submittal.
 - 1. Describe nature of the work and how it is to be performed, indicating why cutting and patching cannot be avoided. Describe anticipated results of the work in terms of changes to existing work, including structural, operational and visual changes as well as other significant elements.
 - 2. List products, equipment, and techniques to be used and firms that will perform work.
 - 3. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
 - b. Include contingency plan addressing additional resources, alternative means of communicating, unexpected defective valves and/or breakers, security arrangements and change in schedule due to resident activities.
 - c. Identify who are the authorized decision makers for the Owner and Contractor. .
 - 4. Give a schedule of dates when work is expected to be performed.
 - 5. List products, equipment, and techniques to be used and firms that will perform work.
 - 6. Where cutting and patching of structural work involves the addition of reinforcement it shall be integrated with original structure to satisfy requirements.
 - 7. Approval by the Architect to proceed with cutting and patching work does not waive the Architect's right to later require complete removal and replacement of work found to be cut and patched in an unsatisfactory manner.
 - 8. Furnish adequate collection and removal of water for concrete cutting and coring.

1.05 QUALITY ASSURANCE

- A. Before cutting and patching decorative finish material to remain in the work, obtain the Architect's approval to proceed. Review cut and patch procedures involved in the work with the Architect prior to start of such work.
- B. Do not cut and patch operational elements or safety related components in a manner that would result in a reduction of their capacity to perform in the manner intended, included energy performance, or that would result in increased maintenance, or decreased operational life or decreased safety.
- C. Cut and patch in a manner that is compatible with the building's aesthetic qualities. Do not cut and patch work in a manner that would result in substantial visual evidence of cut and patch work. Review cut and patch procedures involved in the work with the Architect prior to start of such work. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- D. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio. Review cutting of structural elements (concrete slab, beams etc) with Architect prior to starting work. Refer to structural drawing for recommendation for cutting and patching of floor slabs. Refer to structural drawing for required lintels for new openings.
 - 1. 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. Timber and primary wood framing
 - g. Structural decking
 - h. Stair systems
 - i. Miscellaneous structural metals
 - j. Exterior curtain wall construction
 - k. Equipment supports
 - l. Piping, ductwork, vessels, and equipment
 2. Cutting and Patching Concrete: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical, electrical trades and Owner. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- E. Operational Elements and Safety Limitations: Do not cut and patch operating elements and safety related components in a manner that results in reducing their capacity to perform as intended or which results in increased maintenance or decreased operational life or safety.
1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
 - a. Shoring, bracing, and sheeting
 - b. Primary operational systems and equipment
 - c. Fire separation assemblies
 - d. Air or smoke barriers
 - e. Fire suppression assemblies
 - f. Mechanical systems piping, ducts and vessels
 - g. Water, moisture, or vapor barriers
 - h. Membranes and flashings
 - i. Equipment supports
 - j. Fire protection systems
 - k. Fire detection and alarm systems
 - l. Sprayed fire-resistive material/fire-rated structural components
 - m. Noise and vibration control elements and systems
 - n. Stairs
 - o. Control systems
 - p. Communication systems
 - q. Conveying systems
 - r. Electrical wiring systems
 - s. Operating systems of special construction
 - t. Elevators
- F. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity which results in reducing their capacity to perform as intended, or which results in increased maintenance or decreased operational life or safety.
1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Equipment supports.
 4. Piping, ductwork, vessels, and equipment.
 5. Noise- and vibration-control elements and systems.

1.06 COORDINATION

- A. Provide cutting of construction for the installation of work, to uncover work for access or inspection, for coordination with other work, or for similar purposes, and provide for patching required to restore surfaces to original or modified condition.
- B. Determine the location and size of opening required for the installation of the work. Cost of cutting and patching shall be borne by the Contractor requiring the opening or access.

- C. Coordinate the locations and installation of sleeves and supporting devices to be installed in the construction for the installation of their work in the new construction.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Provide same products or types of construction as that in existing structure, as needed to patch, extend, or match existing work. Generally, Contract Documents do not define product or standards of installation present in existing construction; Contractor shall determine products by inspection and necessary testing and installation by use of the existing as a sample for comparison.
- B. Materials for patching shall match existing adjacent surfaces to the fullest extent possible with regard to visual effect and installed performance characteristics.
- C. Presence of a product, finish, or type of construction, required that patching extending, or matching shall be performed as necessary to make work complete and result in equal or better standards of quality.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Before cutting existing surfaces, examine the surfaces to be cut and patched and the conditions under which the work is to be performed. If unsafe or otherwise unsatisfactory conditions are encountered, take corrective action before proceeding with the work.
- B. Before the start of cutting work, coordinate layout of the work and resolve potential conflicts before proceeding.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Temporary Support: Provide temporary support to ensure structural integrity of affected portions of Work.
 - 1. Provide devices and methods to protect other portions of Project from damage.
 - 2. Provide materials and control operations to prevent spread of dust in surrounding area. Provide drop cloths or other suitable barriers.
- B. Protect in place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for that part of the project that may be exposed during cutting and patching operations.
- C. Take precautions not to cut existing pipe scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 PERFORMANCE

- A. Perform cutting and removal of existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- B. Employ skilled workmen capable of matching existing quality of existing construction to perform cutting and patching work. Proceed with cutting and patching at the earliest feasible time and complete work without delay.
- C. 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 minimize or preferably to prevent interruption to occupied areas.
- D. Cut, fit and patch, including excavation and backfill, to complete Work and to:
 - 1. Fit several parts together, to integrate with other work.

2. Uncover portions of work to provide for installation of ill-timed work.
3. Remove and replace defective work.
4. Remove and replace work not conforming to requirements of Contract Documents.
5. Remove samples of installed work as necessary for testing.
6. Provide openings in elements of work for penetrations of plumbing, mechanical, and electrical work.
7. Uncover work to allow for Architect's observation of covered work which has been covered up prior to required observation by Architect.

3.04 CUTTING AND REMOVAL REQUIREMENTS

- A. Cut and remove existing construction as required, to accomplish the Work. Where new Work is to be installed in or adjacent to existing construction or existing work is to be replaced, remove or cut the existing construction as necessary to complete the Work of the Project.
- B. Execute work with care. Existing construction that is to remain which is loosened, cracked, or otherwise damaged or defaced as a result of the cutting and is unsuitable for use intended shall be removed and replaced at no additional cost to the Owner.
- C. Perform cutting and removal work to remove minimum materials and surfaces necessary using methods that are least likely to damage elements to be retained. Protect adjoining finishes to remain from damage.
 1. In general, where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut through masonry using a cutting machine such as a carborundum saw or diamond core drill to ensure a neat hole. Cut finish surfaces such as masonry, clay tiles or metals using methods to terminate surfaces in a straight line at a natural point of division. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces. Temporarily cover openings when not in use.
 2. By-pass utility services such as pipe, before cutting, where such utility services are shown or required to be removed, relocated or abandoned. Cut off pipe in walls or partitions to be removed. After by-pass and cutting; cap, valve or plug and seal tight remaining portion of pipe and conduit to prevent entrance of moisture or other foreign matter.
 3. 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.
 4. Remove existing construction as noted or required to be removed in order to accommodate new work.
- D. Where removal of walls or partitions extends from one finish surface to another, patch and repair floor and wall surfaces to provide an even surface of uniform color and appearance. Remove existing floor and wall finish materials and replace with new materials, if necessary to achieve uniform color and appearance, with no evidence of patching.

3.05 PATCHING REQUIREMENTS

- A. Patch or otherwise restore disturbed existing construction as indicated on the drawings and schedules, or as otherwise required to restore the work and surfaces. Patching or restoration shall be carried to natural breaks (i.e., corners) wherever possible. Where existing construction is removed, cut or otherwise disturbed by Work of the Project, patch defective and incomplete surfaces. Repair any damage to existing construction which is to remain.
- B. Patching work shall be done by skilled mechanics experienced in the particular type of work involved and shall conform to the standards of the Specifications.
- C. Patch existing construction to match existing work (unless otherwise called for) except provide new materials and accomplish as for new work. Examine existing surfaces to be patched before proceeding with the work. Report all conditions where existing materials, colors and finishes cannot be matched to the Architect, and do not proceed until instructions have been given.
- D. Construction that has been damaged as a result of the Work shall be repaired to an extent and as required to match adjacent existing undamaged construction.
- E. Patch with durable seams that are as invisible as possible. Comply with specified tolerances for the work.

1. Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work.
 2. Fit work tight to new sleeves, pipes, ducts, conduits and other penetrations through the wall surface.
 3. At penetrations of fire rated wall and ceiling or floor construction, completely seal voids with fire-resistive sealant materials in accordance with Section 07 84 00 – Firestopping, to full thickness of the penetrated element.
 4. Inspect and test patched areas to verify integrity of the installation.
 5. Restore surfaces and conditions exposed by removal of existing equipment, features and items, i.e., holes, recesses, interruption of continuity of finishes, etc.
 6. 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.
 7. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 8. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- F. Holes in openings left after removal of items under selective demolition must be filled with like construction to match adjacent finish.
- G. Restoration: Except where indicated otherwise, restore exposed finishes of patched areas to match adjacent surfaces and where necessary extend finish restoration into retained adjoining surfaces in manner which will eliminate evidence of patching and refinishing. Thoroughly clean surfaces prior to application of paint and other finishes.
1. Where patching occurs in previously painted surface, provide appropriate prime coat followed by first finish coat of paint. Provide final finish coat over entire area containing patch; for continuous surface extend to nearest vertical break or intersection, for an assembly refinish entire unit. Except where indicated otherwise, finish in sheen and color to match adjacent surfaces.

3.06 CLEANING

- A. Thoroughly clean areas and spaces where cutting and patching work is performed or used as access to work.
- B. At completion of work of each trade, clean area and make surfaces ready for work of successive trades.
- C. Perform progress cleaning as specified in Section 01 73 00 – Execution.

END OF SECTION

SECTION 01 77 19
CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion
 - 2. Final Completion
 - 3. List Of Incomplete Items (Punch List)
 - 4. As-built Documents
 - 5. Operation and Maintenance Manuals
 - 6. Warranties Requirements
 - 7. Startup and Commissioning
 - 8. Demonstration and Training
 - 9. Repair Of The Work
 - 10. Final Cleaning
- B. Related Sections include the following:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
 - 2. Divisions 02 through 49 Sections for specific closeout requirements for products of those Sections.
- C. The administration of the closeout submittals including, but not limited to, As-Built Documents and Operation and Maintenance Manuals shall be an ongoing development throughout the entire project by the Contractor which will be monitored on a regular basis by the Architect and Owner's Representative.

1.02 DESCRIPTION OF REQUIREMENTS

- A. Definitions: Closeout is hereby defined to include general requirements near end of Contract Time, in preparation for final acceptance, final payment, normal termination of contract, occupancy by Owner and similar actions evidencing completion of the Work.
 - 1. Specified requirements for individual units of Work are specified in sections of Divisions 01 through 49.
 - 2. Time of closeout is directly related to "Substantial Completion," and therefore may be either a single time period for entire Work or a series of time periods for individual parts of the Work which have been certified as substantially complete at different dates. That time variation (if any) shall be applicable to other provisions of this section.
 - 3. All items listed on the Certificate of Substantial Completion must be completed and all closeout requirements submitted to the Architect within sixty (60) days of the date of the Certificate of Substantial Completion. Failure to do so will result in issuance of a 72-hour notice to surety of record.

1.03 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.04 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.05 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Advise Owner of pending insurance changeover requirements.
 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 5. Prepare and submit As-Built Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 7. Complete startup testing of systems.
 8. Submit test/adjust/balance records.
 9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 10. Advise Owner of changeover in heat and other utilities.
 11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 12. Complete final cleaning requirements, including touchup painting.
 13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect and Owner's Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form initial "punch-list" for final acceptance.

1.06 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
 2. Submit updated final statement, accounting for additional (final) changes to Contract Sum.
 3. Submit copy of final punch-list of itemized Work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by the Architect.
 4. Revise and submit evidence of final, continuing insurance coverage complying with insurance requirements.
 5. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents.
 6. Obtain and submit releases enabling Owner's full and unrestricted use of Work and access to services and utilities, including (where required) occupancy permits, operating certificates, and similar releases.
 7. Make final change-over of locks and transmit keys to Owner, and advise Owner's personnel of change-over in security provisions.
 8. Submit As-Built drawings, maintenance manuals, and similar final record information.
 9. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities and services from the project site, along with construction tools, facilities and similar items.
 10. Complete final cleaning up requirements.

- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect and Owner's Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.07 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Owner's Representative.
 - e. Name of Contractor.
 - f. Page number.
- B. Re-inspection procedure: Upon receipt of Contractor's notice that the Work has been completed, including punch-list items resulting from earlier inspections, and excepting incomplete items delayed because of acceptable circumstances, Architect will re-inspect the Work. Upon completion of re-inspection, Architect will either prepare certificate of final acceptance or advise Contractor of Work not completed or obligations not fulfilled as required for final acceptance. If necessary, procedure will be repeated.

1.08 AS-BUILT DOCUMENTS

- A. General: Do not use As-Built Documents for construction purposes. Protect As-Built Documents from deterioration and loss. Provide access to As-Built Documents for Architect's and Owner's Representative's reference during normal working hours.
- B. The Contractor shall maintain a set of As-Built Documents at the site, on which variations shall be accurately marked with red erasable pencil on a daily basis. All changes, whether resulting from change orders, Architect's supplementary instructions, Contractor change directives, or other job noted changes, shall be recorded. The Architect will periodically verify that this is being done satisfactorily.
- C. As-Built Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
 - 1. Mark drawings to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up As-Built Prints.
 - a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - d. Mark Contract 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 Contract Drawings.
 - 2. Mark As-Built sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 - 3. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 4. Note Change Order numbers, alternate numbers, and similar identification where applicable.

5. Identify and date each As-Built Drawing; include the designation "PROJECT AS-BUILT DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Print the Owner Project Number and Name, and drawing numbers and titles on the cover sheet.
- D. Provide one CD of electronic AutoCad/Revit files of Record Drawings and additional print copies as requested (up to 3 sets) to the Architect. Provide a copy of the transmittal letters to the Owner's Representative.
- E. As-Built Specifications: Maintain a clean, undamaged, complete set of the Project Specifications to use as the As-Built Documents. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Note related Change Orders and As-Built Drawings, where applicable.
- F. Miscellaneous As-Built Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.09 OPERATION AND MAINTENANCE MANUALS

- A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system and submit as one package before making application for final payment. Include operation and maintenance data required in individual Specification Sections and as follows:
 1. General:
 - a. In order to communicate to all necessary Owner personnel the starting date of the one year correction period, include a copy of the executed Certificate(s) of Substantial Completion.
 - b. Documentation of manufacturer's initial startup.
 - c. Record copy of test results, affidavits, certificates, approvals, and inspections required by the Contract Documents.
 - d. Owner equipment forms for each applicable piece of equipment.
 2. Operation Data:
 - a. Emergency instructions and procedures.
 - b. System, subsystem, and equipment descriptions, including operating standards.
 - c. Performance and design criteria if Contractor is delegated design responsibility.
 - d. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
 - e. Description of controls and sequence of operations.
 - f. Wiring, control and piping diagrams.
 3. Operating Procedures: 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. Instructions on stopping.
 - f. Normal shutdown instructions.
 - g. Seasonal and weekend operating instructions.
 - h. Required sequences for electric or electronic systems.
 - i. Special operating instructions and procedures.
 4. Maintenance Data:
 - a. Manufacturer's information, including list of spare parts and local service organization.
 - b. Name, address, and telephone number of Installer or supplier.
 - c. Maintenance procedures.

- d. Preventative maintenance inspections, testing, service, lubrication, maintenance instructions and schedules.
 - e. Maintenance record forms.
 - f. Sources of spare parts and maintenance materials.
 - g. Copies of maintenance service agreements.
 - h. Signed copies of guarantees, warranties and bonds.
- B. Manuals, Electronic Files: Submit manuals in the form of a 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 Organization: Enable organization of individual documents based upon 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 files.
 - a. Create composite manual with bookmarks, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel upon opening file.
 - b. Name, configure, and organize files and in accordance with COBIE procedures.
- C. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold (8-1/2-by-11-inch) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders, if necessary, to provide essential information for proper operation or maintenance of equipment or system.
 - b. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - c. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 - d. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 - e. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - 1) If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - 2) Avoid placing loose, oversize drawings in binder pockets. Use reduced drawings or place folded drawings in labeled envelopes bound in manual.
 - 3) If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
- D. Arrange the manuals according to specification section numbers used in the Project Manual, include a table of contents that identifies the responsible installing contractor, contact person, and telephone number with area code and thumb tab index sheets.
- E. The Contractor shall instruct Owner personnel in the use of Maintenance and Operating Manuals.

1.10 WARRANTIES REQUIREMENTS

- A. Refer to individual sections of Divisions 02 through 49 for the determination of units of Work which are required to be specifically or individually warranted, and for the specific requirements and terms of those warranties (or guarantees).
- B. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on

product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

- C. **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.
- D. **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.
- E. **Replacement Cost:** Upon determination that Work covered by the warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirement of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- F. **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 the 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.
 - 1. 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.
- G. When the Contract documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.
- H. Submit written warranties to the Architect prior to the date for Final Completion. If the Architect's certificate of Final completion designates a commencement date for warranties other than the date of Final completion for the Work, or a designated portion of the work, submit written warranties upon request of the Architect.
- I. When the Contract documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Architect, for approval prior to final execution. Refer to Divisions 02 through 50 sections for specific content requirements and particular requirements for submitting special warranties.
- J. At Final Completion compile 2 copies of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual. When warranted construction requires operation and maintenance manuals provide additional copies of each required warranty, as necessary, for inclusion in each manual.
 - 1. Bind warranties in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 - 4. Scan warranties and assemble complete warranty submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.
 - 5. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 – PRODUCTS

2.01 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.

PART 3 – EXECUTION

3.01 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. 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.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 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.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, 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.
 - 1. 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.
- F. 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 operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in this Section.

3.02 STARTUP & COMMISSIONING

- A. This article includes procedures for start-up and commissioning of Plumbing equipment and systems, Fire Protection equipment and system, HVAC equipment and systems, and Electric equipment and systems, under the supervision of the Architect.
- B. Each Subcontractor shall be fully responsible to manage and complete the Commissioning Process. Each Subcontractor shall designate an individual that will be responsible for overseeing the entire process and will be present at each activity to direct the process. A plan and schedule shall be submitted by the Subcontractor that will include a list of activities and milestone dates. This will fit into the master construction schedule.
- C. Each Subcontractor will provide documentation, testing, and will otherwise demonstrate that equipment and systems perform and operate as specified. Required documentation and testing are generally indicated throughout the contract documents.
- D. In general, for each discipline, commissioning will consist of:
 - 1. Shop Drawing Submittals: Each Subcontractor will submit shop drawings for all equipment and materials to be used, as specified, and as required by the Shop Drawing Submittal Log.
 - 2. Testing and Inspections: Each Subcontractor will arrange for and schedule testing and inspections, as required by the corresponding Authority Having Jurisdiction (AHJ). Subcontractors will advise the Contractor in advance of all scheduled inspections. Subcontractors will maintain documentation of all scheduled inspections for incorporation into the as-built documents.
 - 3. Each Subcontractor will perform testing of materials and assembled systems as specified. Representatives of the Owner, and Architect, in part or in whole, will witness all specified testing.

4. The Owner, and Architect will regularly inspect and evaluate installed work. Directives for corrective action will be issued in writing. Each Subcontractor will correct deficiencies as required, and will return the written directive, indicating that the corrective work has been completed.
5. Performance Testing for Equipment and Systems: Each Subcontractor will demonstrate that individual pieces of equipment perform as specified. Performance testing for equipment will be as specified, and as indicated herein. Performance testing will be performed in the presence of the Owner, and Architect.
6. Balancing of Systems: Each Subcontractor will balance dynamic systems as specified and indicated herein.
7. Demonstration of Sequences of Operation: Each Subcontractor will demonstrate that equipment and systems operate in the sequences specified. The demonstration of sequences of operation will be conducted in the presence of the Owner, and Architect.
8. Instruction of the Owner: Each Subcontractor will instruct the Owner in the operation and maintenance of each piece of system and associated equipment. Instruction will be comprehensive and will adhere to the outline syllabus contained herein. Each Subcontractor must video tape each training session and provide video tapes from equipment vendors that give clear instruction on the operation and maintenance of their equipment.
9. As-built Documentation: Each Subcontractor will maintain and compile as-built documents as specified and indicated herein.

3.03 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Provide instructors experienced in operation and maintenance procedures.
 2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 3. Schedule training with Owner through Owner's Representative with at least seven days' advance notice.
 4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
 5. Provide DVD of Training Video. Video of on-site training is permitted.
- B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
 1. System design and operational philosophy.
 2. Review of documentation.
 3. Operations.
 4. Adjustments.
 5. Troubleshooting.
 6. Maintenance.
 7. Repair.

3.04 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial 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. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 3. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that 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.
- 4. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
- 5. 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.

3.05 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. The entire project area shall be cleaned immediately prior to final inspection.
 - 2. When punch list work generates dust and debris, an additional cleaning will be needed prior to occupancy.
- B. Provide final cleaning of the Work when indicated, employing experienced workers or a professional cleaning company for final cleaning. Clean each surface or unit of work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's specific instructions for cleaning operations for materials installed and specified herein.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of the 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, tunnels, pipe spaces, crawl spaces, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Vacuum clean and mop resilient flooring surfaces.
 - k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - l. Remove labels and adhesives that are not permanent.
 - m. Touch up and otherwise repair and restore marred, exposed finishes and surfaces.
 - n. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - o. Replace parts subject to unusual operating conditions.
 - p. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - q. Clean interior of cabinets and casework, converters, unit heaters, radiation, electric panels, and similar items.
 - r. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - s. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - t. 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.
 - u. Leave Project clean and ready for occupancy.

- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. 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.

END OF SECTION

SECTION 02 41 19
SELECTIVE DEMOLITION

PART 1 – GENERAL

1.01 SUMMARY

- A. This section includes the following:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
 - 4. Removal and disposal of all debris.
 - 5. Disconnecting and relocating/reinstalling any existing utility lines on the site which interferes with the repairs.
 - 6. Protection of all existing electrical systems, mechanical equipment, light fixtures, overhead piping, fire protection system etc. scheduled to remain.
- B. Related Sections:
 - 1. Drawings and general provisions of Contract, including General Conditions and Division 01 Specification sections, apply to Work of this section.
 - 2. Document 00 71 00 – Contracting Definitions

1.02 DEFINITIONS

- A. Demolish: The term "demolish" shall mean to wreck or destroy a structure or building system assembly (such as floor or ceiling system, walls or partitions, etc.) and the removal of wrecked materials from the job site. Where new work is not specified for the adjoining surface, selective demolition shall require "cutting and patching" wherever demolished portions of a structure adjoin portions to remain.
- B. 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.
- C. Protect: Section 01 42 00.
- D. Remove: The term "remove" shall mean to detach or separate an item, component or assembly from its installed location, and dispose of same. Removal shall be accomplished without damage to adjacent materials, components or systems that are to remain. Damage that must be incurred during removal shall be repaired as cutting and patching.
- E. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated or where required as new work.
- F. Salvage: The term "salvage" shall mean the removal of items, components, equipment or materials from their installed location, and protection and storage of such items, components, equipment or materials. Salvaged items will be designated either to be re-installed in the Work, stored, or turned over to the Owner or other designated entity, plus such other work as described.

1.03 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials become Contractor's property; remove from Project site.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.04 ACTION SUBMITTALS

- A. Prepare submittals in accordance with the provisions of Section 01 33 00 – Submittal Procedures.

- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust and noise control. Indicate proposed locations and construction of barriers.
- C. Prior to commencement of demolition work, contractors shall submit a schedule of work detailing all anticipated demolition and removal procedures and operations. Schedule shall be approved by the Architect. Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure building's staff on-site operations are uninterrupted.
 - 2. 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. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 - 6. Means of protection for items to remain and items in path of waste removal from building.
- D. Prepare and submit for approval, drawings of the portions of existing building where openings will be cut in existing construction, showing size and location of openings to be made in existing construction.
- E. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of selective demolition.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 77 19 – Closeout Requirements.
- B. Accurately record actual locations of capped utilities, subsurface obstructions, and utility lines, on project record documents.

1.06 QUALITY ASSURANCE

- A. Applicable federal law and local codes shall apply to work under this section including, but not limited to, the following:
 - 1. National Fire Protection Association
 - 2. National Electric Code
- B. Do not use jack hammers or other heavy duty impacting type tools for demolition work without permission of the Architect.
- C. Verify that utility supply lines have been shut off before removal.
- D. Provide fire extinguishers on site of multi-use type during demolition work.
- E. Comply with applicable safety codes for demolition work.
- F. Pay all required fees and obtain all necessary permits and licenses required for demolition work.

1.07 REGULATORY REQUIREMENTS

- A. Conform to the applicable requirements of the Ohio Building Code, Ohio EPA regulations, for demolition of structures, safety of adjacent structures, dust control, and disposal procedures.
- B. Obtain necessary permits from authorities having jurisdiction.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.
- E. Do not close or obstruct egress width to exits. Maintain protected egress and access at all times.

1.08 PROJECT CONDITIONS

- A. Carefully inspect the construction work area and items designated to be removed or preserved. Refer questions to the Architect before proceeding with the work.
- B. Refer to the Drawings for extent of selective demolition and removal work.

- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. 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 Architect.

3.02 PROTECTION REQUIREMENTS

- A. Selective Demolition Protection Procedures:
 - 1. Provide protective measures required by this specification in excess of those requirements for temporary protection specified under Section 01 50 00 – Temporary Facilities and Controls.
 - 2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished, and adjacent facilities or work to remain. Ensure safe passage around areas of demolition. Prevent injury to adjacent facilities. Erect temporary covered passageways as required by authorities having jurisdiction.
 - 3. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
 - 4. Remove temporary protections required by this section at completion of selective demolition work.
- B. Protect, support and maintain all conduits, drains, sewers, pipes, and wires to remain and which are subject to damage by construction activities.
 - 1. Notify Architect if wires, conduits, pipes or other utilities serving building functions will be affected by demolition or remodeling before commencing such operations.
 - 2. Disconnect and cap pipes and utilities as required and as necessary for demolition and alteration work.
 - 3. Identify and indicate capping locations on Project Record Documents.
- C. Provide protection for existing building surfaces and building components such that there is no possibility of damage to same, from demolition operations caused by impact, nicking, scratching, staining, or spillage of materials.
- D. The protection system selected shall not be anchored to existing building finish surfaces or building components.
- E. Protect items to be reused and relocated in construction. Refer to drawing notes.
- F. Protection of Existing Surfaces:
 - 1. Provide at minimum, protection levels specified in Section 01 50 00 – Temporary Facilities and Controls.
 - 2. When removing portions of walls, partitions, or other vertical construction, or portions of vertical construction which is not to be totally demolished, provide floor covering protection on both sides of construction being demolished a distance of at least 4 feet or to the adjacent wall, whichever is the lesser distance.

3.03 UTILITY SERVICES

- A. Existing Utilities/Systems to Remain: Maintain services/systems indicated to remain if any, and protect them against damage during selective demolition operations.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off 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 utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, 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 on Drawings 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 and leave in place.
 - 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 and leave in place.
- C. Utility Requirements: Refer to Facilities Services Subgroup Divisions for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.04 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
 - 2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 3. Protect existing site improvements, appurtenances, and landscaping to remain.
- B. Temporary Facilities: 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 area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces 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. Existing Facilities: Comply with specification requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

6. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 – Temporary Facilities and Controls.
- C. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
- D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction 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.
 2. Remove temporary barricades and protections where hazards no longer exist.

3.05 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. 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. Do not use power driven impact tools. 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 until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 - a. Maintain adequate ventilation when using 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.
- B. Remove all hangers, supports, miscellaneous framing and similar items used to support work to be demolished and removed.
- C. Removed and Salvaged Items: Comply with the following:
 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 authorized storage area.
 4. Protect items from damage during transport and storage.
 5. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 6. Pack or crate items after cleaning and repairing. Identify contents of containers.
 7. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 1. Prepare for reuse, clean, repair, refurbish, refinish or modify as indicated elsewhere in the Contract Documents.
 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.
- E. 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 during selective demolition and cleaned and reinstalled in their original locations, or in locations indicated, after selective demolition operations are complete.

3.06 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Refer to Section 01 73 29 – Cutting and Patching for additional direction.
- B. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- D. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- E. Roofing: Remove no more existing roofing than can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Refer to Division 07 Section "Preparation for Re-roofing" and other roofing related sections for new roofing requirements.
 1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.

3.07 DISPOSITION OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them.
 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. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent. As work progresses, remove from site and legally dispose of all materials, products and debris removed during demolition work and not scheduled to be either salvaged or re-used.
- B. Clean interior and exterior areas used for removal routes of debris.
- C. Remove temporary work related to selective demolition operations upon completion of the work.

3.08 CLEANUP AND REPAIR

- A. General: Upon completion of demolition work, remove tools, equipment, and demolished materials from site.
 1. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.
- B. Upon completion of work, leave premises clean, neat and orderly and acceptable to the Architect.

END OF SECTION

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
 - 2. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.02 DEFINITIONS

- A. Cementitious Materials: Portland or Portland-Limestone cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.03 ACTION SUBMITTALS

- A. Product Data: For each of the following.
 - 1. Portland cement.
 - 2. Portland-limestone cement.
 - 3. Fly ash.
 - 4. Slag cement.
 - 5. Aggregates.
 - 6. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- B. Design Mixtures: For each concrete mixture, include the following:
 - 1. Mixture identification.
 - 2. Minimum 28-day compressive strength.
 - 3. Durability exposure class.
 - 4. Maximum w/cm.
 - 5. Calculated equilibrium unit weight, for lightweight concrete.
 - 6. Slump limit.
 - 7. Air content.
 - 8. Nominal maximum aggregate size.
 - 9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
 - 10. Intended placement method.
 - 11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 - 1. Installer: Include copies of applicable ACI certificates.
 - 2. Ready-mixed concrete manufacturer.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.

2. Admixtures.
3. Curing compounds.
4. Floor and slab treatments.
5. Vapor retarders.
6. Semirigid joint filler.
7. Joint-filler strips.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Portland-Limestone cement.
3. Fly ash.
4. Slag cement.
5. Aggregates.
6. Admixtures:

D. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1.06 |. DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.07 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 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 temperatures.
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 the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.

1.08 Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas. WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.02 CONCRETE MATERIALS

- A. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
 - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
 - 3. Obtain aggregate from single source.
 - 4. Obtain each type of admixture from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
 - 2. Portland-Limestone Cement: ASTM C595, Type 1L.
 - 3. Fly Ash: ASTM C618, Class C or F.
 - 4. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Retarding Admixture: ASTM C494/C494M, Type B.
 - 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 - 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
 - 7. Set-Accelerating Admixture: ASTM C494/C494M, Type C.
- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable or

2.03 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Reef Industries, Inc.
 - b. Stego Industries, LLC.
 - c. W.R. Meadows, Inc.
 - d. .

2.04 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing 3/8-inch sieve.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.
 - b. Laticrete International, Inc.
 - c. Metalcrete Industries.
 - d. Insert manufacturer's name.

2.05 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bon Tool Co.
 - b. Brickform; a division of Solomon Colors.
 - c. ChemMasters, Inc.
 - d. Dayton Superior.
 - e. Euclid Chemical Company (The); an RPM company.
 - f. Lambert Corporation.
 - g. Laticrete International, Inc.
 - h. Metalcrete Industries.
 - i. Nox-Crete Products Group.
 - j. Sika Corporation.
 - k. SINAK Corporation.
 - l. SpecChem, LLC.
 - m. TK Products.
 - n. Vexcon Chemicals Inc.
 - o. W.R. Meadows, Inc.
 - p. .
- B. Water: Potable or complying with ASTM C1602/C1602M.

2.06 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1752, cork or self-expanding cork.

2.07 REPAIR MATERIALS

- A. 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 C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 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 in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 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 in accordance with ASTM C109/C109M.

2.08 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement or portland-limestone cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.

2. Slag Cement: 50 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 1. Use water-reducing high-range 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.
- D. See General Notes for Concrete Mixture Information.

2.09 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 2. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. 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. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.03 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 2. Face laps away from exposed direction of concrete pour.
 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.04 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- 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 on Drawings or as approved by Architect.
 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. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated.
 - 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: 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 on Drawings.
 - 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.05 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 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.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is 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.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 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.
- E. 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 the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.06 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
 1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
- C. Float Finish :
 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
 3. Apply float finish to surfaces to receive trowel finish.
- D. Trowel Finish :
 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 2. Continue troweling passes and restraighen 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 coverings.
 4. Do not add water to concrete surface.
 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
 6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
- E. Broom Finish : Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 2. Coordinate required final finish with Architect before application.
- F. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings
 1. Apply in accordance with manufacturer's written instructions and as follows:
 - a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications.
 - b. Tamp aggregate flush with surface, but do not force below surface.
 - c. After broadcasting and tamping, apply float finish.
 - d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

3.07 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 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 Sheetting Materials: Cover exposed concrete surfaces with sheetting 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.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

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 the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted 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, the following:
 - a) Water.
 - b) Continuous water-fog spray.

3.08 TOLERANCES

- A. Conform to ACI 117.

3.09 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least six months.
 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 joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. 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 surface defects, including 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. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- D. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.11 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Batch Tickets: 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 at Project site.
 - 1. See Contract Documents for Special Inspections.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C143/C143M:
 - a. 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.
 - b. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; .
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure four 6-inch by 12-inch or five 4-inch by 8-inch cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one laboratory-cured specimen at seven days and one set of two 6-inch by 12-inch or three 4-inch by 8-inch specimens at 28 days. Hold one specimen for additional testing if required.
7. Strength of each concrete mixture will be satisfactory if every average of any three 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 if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
8. 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.
9. Additional Tests:
 - a. Testing and inspecting agency to 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.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.12 PROTECTION

- A. 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 concrete surfaces.
 5. Prohibit placement of steel items on concrete surfaces.
 6. Prohibit use of acids or acidic detergents over concrete surfaces.
 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 04 01 00
MAINTENANCE OF MASONRY

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Selective removal of deteriorated mortar joints in concrete masonry units (CMU).
 - 2. Tuckpointing of interior joints in exterior CMU bearing walls.
 - 3. Cleaning of masonry surfaces adjacent to repaired joints.

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM C270 – Standard Specification for Mortar for Unit Masonry.
 - 2. ASTM C780 – Standard Test Method for Preconstruction and Construction Evaluation of Mortars.
 - 3. ASTM E514 – Standard Test Method for Water Penetration and Leakage Through Masonry.
- B. TMS 402/602 – Building Code Requirements and Specification for Masonry Structures.

1.03 ACTION SUBMITTALS

- A. Prepare and submit the following in accordance with Section 01 33 00 – Submittal Procedures:
- B. Product Data - Provide for the following specified products:
 - 1. Masonry repair mortar
- C. Mix design:
 - 1. Site-mixed mortar: Submit proposed mix design for review and approval.

1.04 QUALITY ASSURANCE

- A. Work not specifically noted on the Drawings or in the specifications shall be in accordance with current recommendations of the National Concrete Masonry Association.
- B. Contractor shall have a minimum of five years successful experience in comparable masonry restoration projects with similar scope and type of unit masonry, and shall employ personnel skilled in the restoration process, handling of this specific unit masonry, and operations indicated.
- C. Obtain materials from same source throughout.
- D. Proportions of mortar, site-mixed or pre-blended mix, will be tested during construction per the mortar aggregate ratio method in ASTM C780. If results do not meet ASTM C270 specified mortar type proportion, additional mortar aggregate ratio tests will be conducted at the contractor's expense after one of the following:
 - 1. Site-mixed mortar: Improve material measurement and demonstrate to the Architect's satisfaction prior to conducting additional tests and continuing the work.
 - 2. Pre-blended dry mortar mix: Review results and site batching methods with the Architect's Representative and manufacturer. Follow recommendations as determined from the review.
- E. During all aspects of the masonry work, the Contractor is responsible for selection, providing, proportioning, and performance of all mortar materials.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pre-blended dry mortar mix for restoration and repair in unopened bags of 80 lb or greater.
- B. Protect masonry restoration materials during storage from wetting by rain or ground water.

- C. Protect mortar components from deterioration by moisture and temperature. Store in dry location or in covered containers. Keep containers tightly closed. Follow material manufacturer's recommendations for storage. Protect mortar components from contamination by intermixture with earth or other materials. Cover sand aggregate stockpile.
- D. Protect liquid components from freezing. Store per manufacturer's temperature recommendations.

1.06 PROJECT CONDITIONS

- A. Hot and Cold Weather Requirements: According to MSJC Specification for Masonry Structures (TMS 602). Additionally, when ambient temperature:
 - 1. Below 40°F or will drop below 40°F within 48 hours: Do not lay masonry units, tuck point mortar joints, wash down or wet surfaces without a heated enclosure set-up and operational. The temperature of the enclosure shall be maintained above 40°F for a minimum of 48 hours after completing any of this Work.
 - 2. Below 40°F: Maintain area of work, masonry materials, equipment, and mortar batching area in a heated enclosure prior to and during the Work. Do not heat water or components for mortar or grout to above 140°F.

PART 2 – PRODUCTS

2.01 MORTAR AND GROUT MATERIALS

- A. Verify mortar materials with the independent testing agency.
 - 1. Portland cement: ASTM C150, Type I
 - 2. Hydrated lime: ASTM C207, Type S
 - 3. Aggregate for mortar: ASTM C144, fine mortar sand
 - 4. Water: Potable water, clean, free of oils, acids, alkalis, salts, organic matter, or other substances in amounts that may be harmful to mortar, grout, or embedded materials.
 - 5. Match size, texture, and gradation of existing mortar
- B. Mortar proportions:
 - 1. Mortar for tuck pointing CMU shall be ASTM C270, Type N. Exact proportions will be as determined from the mortar aggregate test results of the mortar pre-installation meeting. The average mortar aggregate ratio of the three samples taken during the pre- installation meeting must meet Type N proportions.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Verify that surfaces to be cleaned and restored are ready for Work of this Section.
- B. Beginning of installation means acceptance of existing surfaces and conditions.
- C. Protect elements surrounding the Work of this Section from damage or disfiguration.

3.02 MORTAR MEASUREMENT AND MIXING

- A. Site-mixed mortar:
 - 1. Method of measurement shall be by dry volume or equivalent weight. Measurement by shovel shall not be permitted.
 - 2. Mix in a clean mechanical batch mixer.
 - 3. Thoroughly mix cementitious and aggregate materials together before adding any water.
 - 4. Mix materials again from 3 to 7 minutes using only enough water to produce a damp, workable mix that retains its form when pressed into a ball.
 - 5. Only tuck pointing and rebuilding mortar must stay in this condition for one to 1-1/2 hours prior to adding remaining water.
 - 6. Add the remaining water in small portions and mix reach proper consistency.

7. Admixtures shall not be used in the mortar, unless otherwise indicated.
8. Mortar may be re-tempered as needed in the first 2-1/2 hours after mixing.

3.03 TUCK POINTING APPLICATION

- A. Solid tuck pointing includes all mortar joints for removal and repointing in a designated areas.
- B. Spot tuck pointing includes removal and repointing of only cracked or deteriorated mortar joints as determined by the Architect, in specifically designated areas for a specified amount (i.e.; linear feet, square feet, or percentage of elevation).
- C. Raking Mortar Joints:
 1. Vacuum dust collection methods are required.
 2. Rake out joints to a minimum depth of 2.5 times the width of the existing mortar joint but not less than that required to reach sound existing mortar.
 3. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar.
 4. Brush, vacuum, or flush joints with water to remove dirt and loose mortar.
 5. Do not spall edges of masonry units or widen joints. Replace units that become damaged.
 6. If power driven tools damage existing masonry in any way, cut out old mortar by hand with chisel and mallet.
 7. Power operated rotary handsaws and grinders will be permitted based on a satisfactory quality control program and demonstrated ability of operators to use tools without damage to masonry. Quality control program shall include provisions for supervising performance and preventing damage due to fatigue.
- D. Tuck Pointing Mortar Joints:
 1. Rinse masonry joint surfaces with water to remove dust and mortar particles. Time application of rinsing so that, at time of pointing, excess water has evaporated or run off, and joint surfaces are damp but free of standing water.
 2. Layers: Mortars for repointing can be applied in single lifts up to a maximum one and one-quarter inch. When the depth of the mortar application exceeds 1-1/4 inch, then divide the application depth by two – for example a joint depth of 1-1/2 inch can be pointed in two 3/4-inch layers. Fully compact each layer and allow it to become thumbprint hard before applying the next layer.
 3. Recess final layer slightly from face. Take care not to spread mortar over edges onto exposed masonry surfaces, or to featheredge mortar.
 4. Tool joints to concave joint or to match existing profile, unless otherwise indicated, when mortar is thumbprint hard.
 5. Brush excess mortar from edges of joint.
 6. Cure mortar by maintaining a damp condition for not less than 72 hours.

3.04 CLEANING

- A. Clean restored masonry in an orderly manner, making sure that all surfaces are clean and a uniform appearance is obtained.
- B. Remove mortar particles with water, nonmetallic scrapers, and fiber bristle brushes. Sandblasting, wet aggregate blasting, or use of other abrasive materials will not be allowed.
- C. Provide an adequate water supply during the cleaning process to assure a thorough presoaking and rinsing of the surfaces.
- D. Remove mortar from surfaces not specified to receive mortar; such as walls, windows, curbs, sidewalks, etc.

END OF SECTION

SECTION 04 22 00
CONCRETE UNIT MASONRY

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes providing reinforced concrete unit masonry construction for exterior and interior walls and including:
 - 1. Mortar and grout
 - 2. Steel reinforcing bars, ties, anchors, and other metal accessories, for anchoring unit masonry together and to other materials.
 - 3. Masonry joint reinforcement.
 - 4. Compressible joint fillers for control joints in unit masonry work and joints with structural steel.
 - 5. Water management flashing
 - 6. Control joints in concrete masonry.
- B. Place, install and build-in, as work progresses, the following products and materials furnished under the indicated Sections:
 - 1. Anchor bolts, wood blocking, and anchorage items furnished or set by other trades as specified in individual Sections.
- C. Related Sections/Drawings:
 - 1. Section 01 45 33 – Special Inspections and Testing.
 - 2. Section 03 30 00 – Cast-In-Place Concrete
 - 3. Division 5 Sections:
 - a. Installation of anchor bolts, bearing plates and loose steel angle lintels furnished under Section 05 12 00 – Structural Metal Framing: Anchor bolts, steel plates, and steel lintels.
 - b. Installation of loose lintels indicated on the Drawings shall be included under the Work of this Section.
 - 4. Section 06 10 00 – Rough Carpentry: For wood bucks and nailing blocks.
 - 5. Section 08 11 00 – Metal Doors and Frames.
 - 6. Structural General Notes on drawings.

1.02 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.03 SYSTEM PERFORMANCE REQUIREMENTS

- A. Compressive Strength: Provide unit masonry that develops a minimum installed design compressive strength f'_m with special inspection of 2,500 psi. Develop the compressive strength of masonry by meeting the minimum unit and mortar strengths specified in the documents or by prism testing in accordance with ASTM C1314.

1.04 REFERENCE STANDARDS

- A. The latest versions of the publications listed below form a part of this specification; comply with provisions of these publications except as otherwise shown or specified.
 - 1. ACI 530/ASCE 5/TMS402: Building Code Requirements for Masonry Structures
 - 2. ACI 530.1/ASCE6/TMS602: Specifications for Masonry Structures
- B. Concrete Unit Masonry Construction: Comply with National Concrete Masonry Association (NCMA) "TEK Bulletins" and as specified.
 - 1. NCMA TEK Bulletin 03-01C "All-Weather Concrete Masonry Construction"
 - 2. NCMA TEK Bulletin 03-02A "Grouting Concrete Masonry Walls."

1.05 INFORMATIONAL SUBMITTALS

- A. Prepare submittals in accordance with Section 01 30 00 – Submittal Procedures for submittal requirements.
- B. Information and Review Submittals:
 - 1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties for each item furnished hereunder.
 - 2. Material certificates: Provide for the following, signed by manufacturer and Contractor certifying that each material complies with requirements.
 - a. Each different cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
 - b. Each material and grade indicated for reinforcing bars.
 - c. Each type and size of joint reinforcement.
 - d. Each type and size of anchors, ties, and metal accessories.
 - 3. Material test reports from a qualified independent laboratory employed and paid by Contractor indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements indicated:
 - a. Mortar complying with the property requirements of, and tested in accordance with ASTM C 270.
 - b. Mortar complying with the proportion requirements of ASTM C 270 and tested in accordance with ASTM C 780.
 - c. Grout mixes: Include description of type and proportions of grout ingredients.
 - d. Masonry units; report for tests performed within the previous six months.
 - 4. Shop drawings:
 - a. Provide elevations of masonry work showing jointing patterns and coursing; indicate locations of expansion and control joints.

1.06 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified:
 - 1. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
 - 2. ASTM C 140-02: Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
- B. Concrete Unit Masonry Construction: Comply with National Concrete Masonry Association (NCMA) "TEK Bulletins" and as specified.
 - 1. NCMA TEK Bulletin 03-02A "Grouting Concrete Masonry Walls."
- C. Obtain masonry units from a single manufacturing source to assure uniform texture and color, for each type required, for each continuous area and visually related areas.
- D. Unit Masonry Producer Qualifications: Producer shall be a member in good standing of the National Concrete Masonry Association (NCMA).
- E. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- F. 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.

1.07 PRE-INSTALLATION CONFERENCE

- A. Prior to the installation of the masonry and associated work, meet at the project site with the installer, the installer of each component of associated work, the installers of other work in and around masonry (including windows), the Architect and other representatives directly concerned with performance of the Work, including (where applicable) insurers, test agencies, product manufacturers, governing authorities,

and the Owner. Record (by masonry contractor) the discussions of the conference and the decisions and agreements (or disagreements) reached and furnish a copy of the record to each party attending. Review foreseeable methods and procedures related to the masonry work, including, but not necessarily limited to, the following.

1. Review project requirements (Drawings, Specifications, and other Contract Documents), including sample panels, job mock-ups, and cleaning procedures.
2. Review required submittals, both completed and yet to be completed.
3. Review status of substrate work, including drying, structural loading limitations, and similar considerations.
4. Review availability of materials, tradesmen, equipment, and facilities needed to make progress and avoid delays.
5. Review required observation, testing, certifying, and accounting procedures.
6. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions, including the possibility of temporary enclosures.
7. Review regulations concerning code compliance, environmental protection, health, safety, fire, and similar considerations.
8. Review procedures needed for protection of masonry during the remainder of the construction period.
9. Consider each party's expert judgment, as advanced in the interest of successful completion of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project Site in manufacturer's original and unopened containers and packaging, bearing labels as to type and names of products and manufacturers.
- B. Protect grout, mortar, and other materials from deterioration by moisture and temperature. Store in a dry place or in waterproof containers. Keep containers tightly closed and away from open flames. Protect liquid components from freezing.
- C. Store masonry in a dry place, off the ground on prepared platforms in a manner to promote air circulation through and around units.
 1. Carefully stack all masonry units, and protect with shed or tarpaulin.
 2. Protect anchors, ties, and reinforcement from elements.
 3. Protect concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.
- D. Handle all masonry units carefully at all times. Do not build units with chipped edges, spalls, or other damage to their appearance into the work.

1.09 PROJECT CONDITIONS

- A. Protect partially completed masonry against weather, when Work is not in progress, by covering top of walls with strong, waterproof, nonstaining membrane. Extend membrane at least 2 foot down both sides of walls and anchor securely in place.
- B. 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.
- C. 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. Protect sills, ledges, and projections from mortar droppings.
- D. Hot and Cold Weather Precautions: Comply with BIA Technical Notes 1A and NCMA TEK 03-01C requirements and the following:
 1. Do not use frozen materials or materials mixed or coated with ice or frost.
 2. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing.
 3. Protect completed masonry work against freezing after laying.

4. Do not use metal reinforcements or anchors coated with loose rust or other coating, including ice, which will reduce or destroy bond.
 5. Dry brush clean exposed masonry with bristle brushes at end of each day's work. Remove mortar spatters and joints ridges.
- E. Masonry Construction Tolerances: Comply with masonry construction tolerances as required by ACI 530.1
- F. Furnish and install all temporary bracing required to prevent damage or stress to masonry work by reason of wind or other loads which may be superimposed on the work. All bracing shall be rigid, secure, and solidly anchored against movement. Remove when no longer required. Be solely responsible for any damage incurred by failure to properly brace and protect against external forces.

PART 2 – PRODUCTS

2.01 MASONRY UNITS – GENERAL

- A. Manufacturer: Obtain masonry units from one manufacturer of uniform texture and color for each kind required, for each continuous area and visually related areas.
- B. Comply with referenced unit masonry standard and other requirements specified in this Section applicable to each material indicated.
- C. The Specification for products furnished and installed under this Section of Work are based on those manufacturers listed herein. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Request for Architect's approval shall be submitted on Substitution Request Form found after the Instructions to Bidders and include complete technical data for evaluation. Requests must be received at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

2.02 CONCRETE MASONRY UNITS

- A. Concrete Masonry Units: All CMU on this project to have minimum compressive strength of 2500 psi on net cross sectional area.
- B. Concrete Masonry Units:
1. Manufacturer: Shall be a member of the National Concrete Masonry Association (NCMA).
 2. Weight Classification: Normal weight.
 3. Size: Manufactured to the actual dimensions listed below (within tolerances specified in the applicable referenced ASTM specification) for the corresponding nominal sizes indicated on the drawings.
 - a. 4 inch nominal: 3-5/8 inch actual.
 - b. 6 inch nominal: 5-5/8 inch actual.
 - c. 8 inch nominal: 7-5/8 inch actual.
 - d. 12 inch nominal: 11-5/8 inch actual.
 4. Special Shapes: Provide, where shown and where required, lintels, corners, jambs, sash, control joints, headers, bond beams, bullnose, and other special conditions.
 5. Exposed Face: Manufacturer's standard color and texture, unless otherwise indicated.
 6. Bond beam units shall be such that where two reinforcing steel bars are required in the bond beams, bars may be located not greater than 2-5/8 inch from both faces of the unit. Bond beam units which do not allow the two bars to be separated and to be within 2 5/8" of each face will not be acceptable.
- C. Load-Bearing CMU: Provide units complying with ASTM C90, with a minimum compressive strength of as indicated in the Structural General Notes.
1. Normal Weight Units: ASTM C33 concrete aggregates for a dry net weight of not less than 125 pounds per cu. ft. Strength shall be as indicated above.
 2. Curing: Cure units to comply with ASTM C90.
- D. Concrete Building Brick: ASTM C55 and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength per structural notes.
 2. Weight Classification: Normal weight.
 3. Size: Manufactured to the actual dimensions listed below (within tolerances specified in the applicable referenced ASTM specification) for the corresponding nominal sizes indicated on the drawings.
 - a. Modular: 3-5/8 inches thick by 2-1/4 inches high by 7-5/8 inches long.
 - b. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
- E. Integral water-repellent for concrete unit masonry: Factory fabricate all exterior- exposed concrete masonry units with Integral water repellent admixture in concrete mix.
1. Fabricate blocks using water-repellent admixture at rate recommended by admixture manufacturer.

2.03 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
1. Natural color.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Masonry Cement: ASTM C 91.
1. Products: Subject to compliance with requirements, provide masonry cement from one of the following manufacturers:
 - a. Capital Materials Corporation; Flamingo Color Masonry Cement.
 - b. Cemex S.A.B. de C.V
 - c. Essroc, Italcementi Group d. Holcim (US) Inc.
 - d. Lafarge North America Inc.;
 - e. Lehigh Cement Company;
 - f. National Cement Company, Inc.
- D. 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.
- E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

2.04 MORTAR 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.
1. Do not use calcium chloride in mortar or grout.
 2. Use masonry cement mortar unless otherwise indicated.
 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 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. Refer to mortar type indicted in Structural General Notes.

2.05 GROUT MIXES

- A. Prepackaged grout (ready mix) complying with ASTM C 1107, or site-mixed Portland cement grout complying with ASTM C 476 may be used.
- B. Grout for Unit Masonry: Comply with ASTM C476 for grout used in construction of reinforced unit masonry; provide grout of consistency (fine or coarse) at time of placement which will completely fill all spaces

intended to receive grout. Combine and thoroughly mix cementitious materials, aggregates and water mechanically for at least 5 minutes using the established mix design. Grout shall have a minimum compressive strength of 3,000 psi at 28 days.

1. Use fine grout in spaces less than 2 inches in least horizontal dimension; use coarse grout in spaces 2 inches or more in least horizontal dimension.
2. Measure and batch materials either by volume or weight such that the required proportions can be accurately controlled and maintained.
3. Mix grout with sufficient water to obtain a fluid pouring consistency without segregation of materials. A low or high range water reducer may be used.
4. Slump shall be between 8 and 11 inches at point of placement.
5. Grout which has hardened or stiffened due to hydration of the cement shall not be used, but in no case shall grout be used 1 hour after initial mixing water has been added to the dry ingredients.

2.06 REINFORCEMENT AND ANCHORAGE MATERIALS

A. Continuous Wire Reinforcing and Ties for Masonry; ASTM A951 and as follows:

1. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M
2. Exterior and Interior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side and Cross Rods: 0.148-inch diameter.
4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
5. Provide welded wire units prefabricated in straight lengths of not less than 10 foot, with matching corner ("L") and intersection ("T") units.
6. Fabricate from cold-drawn steel wire complying with ASTM A1064, 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.
7. Configurations:
 - a. Single Wythe CMU:
 - 1) Ladder type, 1 side rod per face shell; between 5/8 inch and 1 inch mortar coverage at each face.
 - 2) Blok-Lok "BL10".
 - 3) Heckmann "1100 Series".
 - 4) H & B "#220 Ladder-Mesh"
8. Wire shall be galvanized and in accordance with the following:
 - a. Joint reinforcement and anchors, interior walls ASTM A641
(0.10 oz. per sq. ft.)
 - b. Joint reinforcement, wire ties, or anchors in exterior walls ASTM A153, Class B2
(1.50 oz. per sq. ft.)
 - c. Sheet metal ties or anchors in exterior walls or a mean relative humidity exceeding 75 percent ASTM A153, Class B2
(1.50 oz. per sq. ft.)
9. All ladder type joint reinforcing shall have cross rods spaced at 16 inches o.c.
10. For joint reinforcing in walls, other than those described above, refer to Drawings for particular requirements.

2.07 MISCELLANEOUS

- A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.
- B. Hot-Dip Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
- C. Steel Sheet, Galvanized after Fabrication: ASTM A 1008 cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153.
- D. Steel Plates, Shapes, and Bars: ASTM A 36.

- E. Anchoring Devices: Provide strap anchors, ties, inserts, bolts, and rods of type and size required.
 - 1. Masonry to Masonry: Strap anchors 1/4-inch x 1-1/4 inches x 24 inches galvanized steel with bent ends.
 - a. Standard: Dur-O-Wal or one of the following: "301Z" Heckman "272 Rigid Steel Anchor" Hohmann & Barnard, Inc. #344 Rigid Partition Anchor, or approved equal.
 - 2. Masonry to Steel: AA Flex-O-Lok AA400, 3/16 inch diameter triangular wire ties and AA 401 1/4 inch diameter wire weld at anchors.
 - 3. Finish: ASTM A153, 1.5 ounce hot-dip galvanized finish for exterior walls; standard mill finish for remaining areas.
- F. 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 0.148-inch steel wire, hot-dip galvanized after fabrication.
 - 1. Provide units with either two loops or four loops as needed for number of bars indicated.
 - 2. Reinforcing Bar Positioners:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
- G. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:
 - 1. Headed bolts.
 - 2. Nonheaded bolts, bent in manner indicated.
- H. Postinstalled Anchors: Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing in accordance with ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Type: Expansion anchors.
 - 2. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.

2.08 EMBEDDED FLASHING MATERIALS

- A. Single-Wythe CMU Flashing System:
 - 1. System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density Polypropylene.
 - 2. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.
 - 3. Attached web covers will span from pan to pan providing protection over the web and the joints of the CMU.
 - 4. Basis-of-Design Product: Subject to compliance with requirements, provide Mortar Net Solutions; BlockFlash
- B. Through-Wall Flashing: York Multi-Flash SS
 - 1. Basis of Design Product/Manufacturer: York Flashings
 - 2. Composition:
 - a. 2 mil Type 304 stainless steel core
 - b. Fully laminated with polymeric film on both sides
 - 3. Total Thickness: Approx. 40 mils
 - 4. Performance:
 - a. Tensile Strength: $\geq 16,000$ psi
 - b. Peel Strength (ASTM D1876): ≥ 4.0 pli
 - c. Water Vapor Permeance (ASTM E96): < 0.05 perms

- C. Flashing Accessories:
 - 1. Termination bar, drip edge, sealants, corner boots, and end dams as recommended by flashing manufacturer.

2.09 MASONRY ACCESSORY MATERIALS

- A. Preformed Control-Joint Gaskets: Styrene butadiene rubber compound conforming to ASTM D2000, Designation M2AA-805, regular design to fit standard sash block, with a durometer hardness of 80 when tested in accordance with ASTM D2240. Manufacturer: Dur-O-Wal "Rapid Control Joint.®" AA Wire Products "AA1000 Titewall," or approved equal.
- B. Compressible Filler: Premolded filler strips complying with ASTM D1056, Type 2, Class A, Grade 1; closed cell neoprene; compressible up to 35 percent; of width and thickness indicated. Manufacturer: Dur-O-Wal Rapid® Soft-Joint/Expansion Joint, AA3405 Joint-Tite of AA Wire Products, Hohmann & Barnard, Inc. #NS Closed Cell Neoprene Sponge, or approved equal.
- C. Masonry Cleaners:
 - 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.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which masonry is to be installed and notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.
 - 1. Examine surfaces which are to support masonry work to assume completion to proper lines and grades. Remove all dirt, laitance, loose aggregates, and other deleterious material.
 - 2. Examine rough-in and built-in construction to verify actual locations prior to installation.
- B. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to masonry installer.
- C. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Remove dirt, ice, loose rust, and scale from metal components prior to installation.
- B. Protect base of exterior walls from splattering of mortar, soil, mud and other materials that might stain the masonry up to 4 feet above grade with a membrane similar to 45 mil EPDM or plywood sheathing material. Maintain protection for the entire duration of the project.
- C. Protect all sills, ledges, and projections from droppings of mortar. Protect door jambs and corners from damage during masonry construction.

3.03 INSTALLATION – GENERAL

- A. Thickness: Build masonry construction to the full thickness shown, except, build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness shown or specified.
- B. Build chases and recesses as shown or required to accommodate items specified in this and other Sections of the Specifications. Provide not less than 8 inches of masonry between chase recess and jamb of openings and between adjacent chases and recesses.
- C. Cut masonry units with motor-driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full-size units without cutting wherever possible.

- D. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.
- E. Establish lines, levels and coursing indicated. Protect from displacement.
- F. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- G. Isolate masonry partitions from vertical structural framing and where indicated on the Drawings. Maintain joints free from mortar, ready to receive sealant and joint bead back-up.
- H. Provide compressible filler at tops of interior masonry partitions abutting structural above.

3.04 PLACING AND BONDING

- A. Build walls and other masonry construction to the full thickness shown. Note rustication coursing.
- B. Lay masonry units in full bed of mortar, with full head and collar joints, uniformly jointed with other work. Use full size units without cutting whenever possible. Provide 100 percent solid units where webs or cores would be exposed.
- C. Lay hollow masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in first course on footings and foundation walls, and adjacent to cells or cavities to be filled with grout.
- D. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
- E. Remove excess mortar as work progresses.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, after mortar has started to harden, remove mortar and replace with fresh mortar.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Leave openings for equipment which is to be installed later in construction. After installation of equipment, complete masonry work to match work adjacent to the openings.
- I. Cut neatly around pipes, conduit, and ducts. Fill cracks with mortar.
- J. Isolate top joint of non-loadbearing masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler, and seal.
- K. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise shown.
- L. Rake out mortar in preparation for application of caulking or sealants where required.

3.05 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. 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 a caulk or insulation filled joint between masonry and the structural roof deck, structural steel framing or structural floor deck at nonrated conditions. At rated walls, provide firestopping.
- D. Lay concrete masonry units in running bond unless otherwise noted with vertical joint in each course centered on units in courses above and below. Provide coursing as indicated on drawings.
 - 1. Form concave tooled mortar joints in all exposed work.
 - 2. Compress and cut joints flush for masonry walls which are below grade, concealed, or covered by other materials.
 - 3. Provide 3/8 inch joint widths, except for minor variations required to maintain bond alignment.
 - 4. 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.

- E. Build non-load-bearing interior partitions full height of story to underside of solid floor structure above, unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 3. At fire-rated partitions, install firestopping in joint between top of partition and underside of structure above to comply with Section 07 84 00 – Firestopping.
- F. Align unit cells or cores that are to be grouted.
- G. Bond and interlock each course of each wythe at corners. Do not use units with less than 4 inches of horizontal face dimensions at corners or jambs.
 - 1. Provide special coursing where indicated.
 - 2. Provide uniform color blending in walls of exposed concrete masonry units to avoid patchy effect.
 - 3. When joining fresh masonry to set or partially set masonry, remove loose unit and mortar, and clean and lightly, wet exposed surface of set masonry prior to laying fresh masonry.
- H. Stopping and Resuming Work: Step back 1/2 masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry, and remove loose masonry units and mortar prior to laying fresh masonry.

3.06 BUILT-IN WORK

- 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. As work progresses, build in metal frames, anchor bolts, bearing plates, reinforcement, inserts, sleeves and other items furnished by other sections. Form chases and openings required for other work.
- C. Provide solid masonry bearing for all lintels, beams, and load-bearing members. Provide solid masonry units or hollow units filled solid.
- D. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod grout into core.
- E. Build in items plumb and level.
- F. Build in work of other trades without weakening or defacing masonry.
- G. Obtain exact sizes of openings for ducts, grilles, louvers, piping, and other work furnished by other trades and properly build around same.
- H. Locate pipe and conduit in walls accurately so as not to weaken the strength of the masonry.
- I. Machine cut masonry neatly for installation of outlet boxes and similar equipment.
- J. Provide anchoring devices of the type indicated and specified for anchoring masonry work. Provide open space not less than 1/2 inch width between masonry and structural member. Keep space free of mortar or other materials.
- K. 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. Draw anchors tight and fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
 - 1. Rake joints around exterior side of exterior hollow metal door frames for sealant.
 - 2. Protect 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.
 - 3. Where hollow metal frames do not wrap around masonry jambs and heads, rub exposed corners of block to remove sharp, irregular edges.

4. Fill cores in hollow concrete masonry units with grout 3 courses (24 inches) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- L. Flashing / Weep System: Install continuously in block courses at base of wall, and above doors, windows and lintels in accordance with manufacturer's installation instructions.
 1. Install core material in empty cells of first course above flashing.
 2. Do not install core material in cells with reinforcing.

3.07 PLACING REINFORCEMENT

- A. General: Comply with requirements of ACI 530.1/ASCE 6/TMS 602. Do not use reinforcement bars with kinks or bends not shown on final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
- B. Position reinforcement accurately at the spacing as indicated on the drawings. The minimum clear distance between bars and masonry units shall be 1/2 inch; and between parallel bars, the minimum clear distance shall be one bar diameter. Provide bars in vertical and horizontal directions as indicated. Reinforcement shall be held in place with centering clips or caging devices. Support and secure bars against displacement; secure vertical bars near each end and at intermediate intervals not exceeding 192 bar diameters. Set horizontal reinforcement in a full bed of mortar.
- C. Splice reinforcement bars where shown; do not splice at other points unless acceptable to the Architect. Provide contact lapped splices, unless otherwise shown. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie. Lap ends not less than 40 bar diameters, unless otherwise indicated, or required by governing code.
- D. Secure reinforcement to insure final position after grouting in accordance with the design requirements.
- E. Bends, extensions, etc. shall comply with OBC requirements.
- F. Tolerances:
 1. Tolerances for the placement of steel in walls and flexural elements shall be $\pm 1/2$ inch when the distance from the centerline of steel to the opposite face of masonry, d , is equal to 8 inches or less, ± 1 inch for d equal to 24 inches or less but greater than 8 inches, and $\pm 1-1/4$ inch for d greater than 24 inches.
 2. Place vertical bars within 2 inches of the required location along the length of the wall.
 3. If it is necessary to move bars more than one bar diameter or a distance exceeding the tolerance stated above to avoid interference with other reinforcing steel, conduits, or embedded items, notify the Architect for acceptance of the resulting arrangement of bars.

3.08 HORIZONTAL JOINT REINFORCEMENT

- A. Provide continuous horizontal joint reinforcement in all unit masonry walls as follows:
 1. Place reinforcing spaced at 16 inches on center vertically, full height of wall and every block course shown on the drawings, except at control/expansion joints.
 2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 24 inches each side of opening.
 3. Place joint reinforcement continuous except at control joints.
 4. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, pipe enclosures and other special conditions.
 5. Lap joint reinforcement ends minimum 6 inches at splices, and provide preformed corners.
- B. Install reinforcing steel and concrete grout specified in Section 03 30 00. Support and secure reinforcing bars from displacement. Comply with drawing details for steel size and spacing. Support and secure reinforcing bars from displacement. Maintain position of reinforcing within 1/2 inch of dimensioned position.
- C. Embed anchors attached to structural steel members and grout solid.

3.09 MASONRY FLASHINGS

- A. Install embedded (concealed) flashing in masonry at shelf angles, lintels, ledges, in the first course above grade and at other obstructions to the downward flow of water in the wall, and where indicated.
- B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing.
- C. Carefully place flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with adhesive/sealant/tape as recommended by flashing manufacturer before covering with mortar. Carefully fit flashing around projections, columns, walls, etc. Install flashing continuous around inside and outside corners using prefabricated corner boots where possible. End laps shall be a minimum of 6 inches and side laps 4 inches all sealed with manufacturers recommended mastic.
- D. Form flashing to correct profile without wrinkles or buckles, and protect from punctures and tears during installation. Install flashing so as to force any moisture entering the wall to the outside and as follows:
 - 1. Extend flashing to outside face of wall and terminate as indicated.
 - 2. Provide concealed flashing in first course above grade or where wall extends above roof and is exposed. Coordinate with roof termination.
 - 3. Install reglets and nailers for flashing and other related work where shown to be built into masonry work. Refer to Section 07 62 00 – Sheet Metal Flashing for reglets.
- E. Install flashing as follows:
 - 1. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. At heads and sills, extend flashing 4 inches at ends and turn flashing up not less than 2 inches to form a pan.
 - 2. Extend sheet metal flashing 1/2 inch beyond face of masonry at exterior and turn flashing down to form a drip.
 - 3. Install metal drip edges beneath flashing at exterior face of wall. Stop flashing 1/2 inch back from outside face of wall and adhere flashing to top of metal drip edge.
- F. Provide end dams at least 4 inches high where flashing is not continuous at wall openings, building expansion joints, and where masonry meets adjacent wall materials and systems. Install flashing in veneer walls carrying flashing up face of sheathing at least 8 inches and behind building felt paper. Bond and seal end dam flashing to wall flashing and seal end dam flashing against end brick.
- G. Extend flashing continuous around corners. Cut, overlap and seal all corner flashing. Extend flashing continuous across vertical control joints. Lap flashing at joint a minimum of 6 inches and seal with joint sealant.
- H. Install concealed flashing in accordance with BIA Technical Notes 7 and SMACNA "Architectural and Sheet Metal Manual" Plates 52 and 53. Extend flashings beyond edge of lintels and sills at least 4 inches. Extend flashing vertically at least 8 inches and build into or anchor to back-up for a complete watertight installation. Seal top edge of flashing anchored to back-up sheathing and stud framing.
- I. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.10 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in- plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
- C. Control joint locations in concrete masonry, unless otherwise shown or detailed:
 - 1. Maximum spacing: Lesser of 1-1/2 times overall wall height or 25 feet and as follows:
 - a. At changes in wall height.
 - b. At changes in wall thickness, such as at pipe chases and pilasters.
 - c. At (above) movement joints in foundations and floors.
 - d. At (below) movement joints in roofs and floors that bear on a wall.

- e. On one side of openings less than six feet wide.
- f. On both sides of openings more than six feet wide.
- g. Adjacent to wall corners and intersections within distance equal to half control joint spacing.

3.11 GROUTING UNIT MASONRY

- A. Grout filled or steel reinforced concrete block masonry foundations or masonry walls shall be reinforced and grouted as detailed on approved shop drawings.
- B. Grout in the block cavities, completely fill each cavity with homogenous grout, extending from the lowest course to the top of the reinforced portion of the foundation or wall. Mortar shall not be used as grout for CMU.
- C. Verify that locations of bond beams, pilasters, and other grouted components are as indicated on Drawings.
- D. Reinforce bond beams as indicated. Comply with drawing details for steel size, quantity, and spacing.
- E. Lap splices minimum 24 bar diameters. Caging devices and centering clips shall be spaced vertically such that every section of vertical reinforcing steel bar is restrained by 2 clips or devices, one near its top and one near its bottom. Maintain position within 1/2 inch of dimensioned position.
- F. The low-lift grouting procedure shall be used as described in the Drawings and in NCMA- TEK 03-02A Grouting for Concrete Masonry Walls. Maximum height of grouting shall be 4 feet. Work grout into masonry cores and cavities to fill all voids.
- G. At bearing locations, fill all masonry cores solid with coarse grout fill to dimensions indicated on the drawings.

3.12 LINTELS

- A. Install loose steel lintels over window openings, door openings, and at other locations shown. Do not bond masonry work to bearing support ends of lintels.

3.13 LINTEL REPLACEMENT

- A. Remove block courses above lintels as detailed and approximately 6 inches beyond ends of existing lintels. Shore remaining masonry above opening. Remove lintel.
- B. Install new steel lintel 8" minimum past opening.
- C. Install sheet metal drip edge on lintel with a 1 inch bead of flashing lap sealant between the sheet metal drip edge and lintel, just behind the lintel leading edge.
- D. Install flashing membrane over the sheet metal drip edge and press into backer with flashing lap sealant down to 2 inch below the brick tie location. Install two 1 inch bands of flashing lap sealant between the flashing membrane and sheet metal drip edge.
- E. Fasten termination bar maximum 6 inch o.c. and 2 inch o.c. from end of the termination bar at the top of the vertical termination of the flashing membrane. Coat termination bar with flashing lap sealant.
- F. Install brick ties maximum 16 o.c. and maximum 8 inch from ends. Cover back plate with flashing lap sealant.
- G. Extend flashing membrane 4 inch minimum past end of lintel and turn flashing up one brick course 2 inch minimum to provide folded end dams or install preformed end dams.
- H. Lap flashing membrane minimum 6 inch and seal with flashing lap sealant in-between laps and over the cut edge.
- I. Lap sheet metal drip edge minimum 4 inch and seal with flashing lap sealant in-between laps.
- J. Install and extend rope weeps at end dam corners with tab extension of flashing membrane and through head joints, maximum 16 inch on-center and lay horizontally along cavity, interlacing with adjacent rope weep, and extend up to and tie to brick ties.
- K. Install replacement insulation and brick above lintel and flashing membrane, toothing into existing masonry.

3.14 REPAIRING, POINTING AND CLEANING

- A. Remove and replace units which are loose, chipped, broken, stained, or otherwise damaged. Provide new masonry units to match adjoining units and install in fresh mortar pointed to eliminate evidence of replacement.
- B. Dry brush masonry surface after mortar has set at the end of each day's work and after final pointing. Remove excess mortar and mortar smears.
- C. Periodically during construction, clean up and remove rubbish from premises.
- D. Upon completion, go over all masonry work and remove and replace defective or open joints and holes with mortar.
- E. Clean walls at a time which will permit a thorough cleaning without damage to any other finished surfaces. Clean soiled surfaces with cleaning solution.
- F. 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. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry 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 masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.15 FIELD QUALITY CONTROL

- A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
- B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof. Test types as determined by the independent testing and inspection agency.

3.16 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 masonry waste and legally dispose of off the Site.

END OF SECTION

SECTION 05 05 13
GALVANIZED STEEL COATINGS AND TREATMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. This section specifies the fabrication, hot-dip galvanizing, post-galvanizing quenching/passivation, surface preparation, and duplex coating system of structural steel for a freestanding observation tower, including stairs, stringers, railings, and guardrails. The **duplex system** shall consist of a basis of design Tnemec epoxy primer, epoxy intermediate, and urethane topcoat compatible with galvanized steel.

1.02 RELATED SECTIONS/DOCUMENTS

- A. Section 05 12 00 – Structural Steel
- B. Section 09 96 00 – High-Performance Coatings

1.03 REFERENCES

- A. ASTM:
 - 1. ASTM A123/A123M – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel
 - 2. ASTM A153 – Zinc Coating (Hot-Dip) on Fasteners
 - 3. ASTM A780 – Repair of Damaged and Uncoated Areas of Galvanizing
 - 4. ASTM D6386 – Chemical Cleaning of Galvanized Steel
- B. SSPC:
 - 1. SSPC-SP1 – Solvent Cleaning
 - 2. SSPC-SP16 – Brush-Off Blast Cleaning of Galvanized Steel
- C. Tnemec Technical Data Sheets: Epoxy primers, epoxy intermediates, and urethane topcoats

1.04 ACTION SUBMITTALS

- A. Product data for coatings and galvanizing process
- B. Shop drawings showing galvanized steel elements and connections
- C. Manufacturer's surface preparation, passivation, and duplex coating instructions
- D. Sample panels for adhesion, finish, and color approval

1.05 QUALITY ASSURANCE

- A. Coating applicator must be certified by Tnemec.
- B. Galvanizing must comply with ASTM A123/A123M.
- C. Coatings must be compatible with hot-dip galvanized steel and suitable for exterior exposure.

PART 2 – PRODUCTS

2.01 STRUCTURAL STEEL

- A. Steel: ASTM A36, A992, or as specified.
- B. Fabricate steel in accordance with structural drawings prior to galvanizing.

2.02 GALVANIZING

- A. Hot-dip galvanize all structural steel after fabrication.
- B. Minimum zinc coating thickness: ASTM A123 Class B (0.040 in / 1.0 mm typical).

- C. Ensure welds, edges, holes, and recesses are fully coated.
- D. Repair damaged galvanizing per ASTM A780 using zinc-rich repair paint.

2.03 QUENCHING / PASSIVATION

- A. Immediately after galvanizing, steel shall be quenched in clean water or a Tnemec-approved chemical passivation solution.
- B. Purpose: remove flux residues, reduce white rust formation, and provide a surface suitable for epoxy adhesion.
- C. After quenching, dry steel thoroughly prior to coating application.

2.04 DUPLEX COATING SYSTEM

Component	Product	Function
Primer	Tnemec Series 91-H2O or N140	Epoxy primer compatible with galvanized steel
Intermediate	Tnemec epoxy intermediate (manufacturer-approved)	Build adhesion and corrosion resistance
Topcoat	Tnemec Series 1074 Endura-Shield or equivalent	UV-resistant urethane finish

- A. All coatings: VOC-compliant
- B. Colors: as selected by Architect
- C. Mix and apply per manufacturer instructions.

PART 3 – EXECUTION

3.01 SURFACE PREPARATION

- A. Inspect galvanized steel for voids, flux residue, weld spatter, or damage.
- B. Clean all surfaces using SSPC-SP1 solvent cleaning. Remove white rust or loose zinc per ASTM D6386.
- C. Optional: Light brush-off blast (SSPC-SP16) or Tnemec-approved conditioning for improved adhesion.
- D. Ensure surfaces are dry, uniform, and free of contaminants prior to coating.

3.02 COATING APPLICATION

- A. Primer Coat: Apply epoxy primer at 2–3 mils DFT per coat; allow to cure per manufacturer schedule.
- B. Intermediate Coat: Apply epoxy intermediate at 2–3 mils DFT, ensuring complete coverage.
- C. Topcoat: Apply urethane topcoat at 2–3 mils DFT, achieving UV and weather protection.
- D. Maintain recommended environmental conditions (temperature, humidity) during application.
- E. Avoid runs, sags, holidays, and streaks.

3.03 INSPECTION & TESTING

- A. Visually inspect for full coverage, smooth finish, and absence of defects.
- B. Measure dry film thickness using appropriate gauge; total system typically 6–9 mils DFT.
- C. Inspect welds, edges, corners, and high-traffic areas for adhesion.
- D. Conduct adhesion tests per ASTM D4541 or Tnemec recommendations.
- E. Submit inspection records to Architect.

3.04 TOUCH-UP AND REPAIRS

- A. Repair damaged or thin areas with same coating system, feathering edges for seamless blending.
- B. Small galvanizing touch-ups: use zinc-rich repair paint per ASTM A780, then reapply coating system.

3.05 PROTECTION

- A. Protect coated surfaces from mechanical damage, dirt, and moisture until fully cured.
- B. Avoid foot traffic on stairs or platforms until minimum cure times are met.
- C. Do not stack or drag steel on coated surfaces.

END OF SECTION

SECTION 051200

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural-steel materials.
 - 2. Shrinkage-resistant grout.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for and other steel items not defined as structural steel.

1.02 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.03 COORDINATION

- A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.04 ACTION SUBMITTALS

- A. 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 supplemental 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. The following statements shall be placed on the front cover or initial sheet of each shop drawing submittal:
 - a. 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 GS-D-07, dated August 1, 2009) 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 _____
- B. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, professional engineer, and testing agency.
- B. Welding certificates.

- C. Mill test reports for structural-steel materials, including chemical and physical properties.
- D. Product Test Reports: For the following:
 - 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. Nonshrink grout
- E. Survey of existing conditions.
- F. Source quality-control reports.
- G. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator with not less than (10) years of successful experience in comparable installation projects and employing personnel skilled in the fabrication processes and operations indicated.
- B. Installer Qualifications: A qualified installer with not less than (10) years of successful experience in comparable installation projects and employing personnel skilled in the installation processes and operations indicated.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.07 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 corrosion 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/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.
 - a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
 - b. Use Allowable Stress Design; data are given at service-load level.
- C. Moment Connections: Type PR, partially restrained.

- D. Construction: Braced frame.
- E. DOMESTIC STEEL USE REQUIREMENTS AS SPECIFIED IN SECTION 153.011 OF THE REVISED CODE APPLY TO THIS PROJECT. COPIES OF SECTION 153.011 MAY BE OBTAINED FROM THE OFFICE OF THE OHIO FACILITIES CONSTRUCTION COMMISSION.

2.02 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M or ASTM A572/A572M, Grade 50.
- B. Channels, Angles, M-Shapes: ASTM A36/A36M.
- C. Channels, Angles, S-Shapes: ASTM A36/A36M.
- D. Plate and Bar: ASTM A36/A36M or ASTM A572/A572M, Grade 50.
- E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C or ASTM A1085/ASTMA1085M structural tubing.
- F. Welding Electrodes: Comply with AWS requirements.

2.03 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
- B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating.

2.04 RODS

- A. Headed Anchor Rods: ASTM F1554, Grade 55, weldable , straight.
 - 1. Nuts: ASTM A563 heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A36/A36M carbon steel.
 - 3. Washers: ASTM F436, Type 1, hardened carbon steel.
 - 4. Finish: Plain Hot-dip zinc coating, ASTM A153/A153M, Class C Mechanically deposited zinc coating, ASTM B695, Class 50.
- B. Threaded Rods: ASTM A36/A36M.
 - 1. Nuts: ASTM A63 heavy-hex carbon steel.
 - 2. Washers: ASTM F436, Type 1, hardened ASTM A36/A36M carbon steel.
 - 3. Finish: Plain Hot-dip zinc coating, ASTM A153/A153M, Class C Mechanically deposited zinc coating, ASTM B695, Class 50.

2.05 FORGED-STEEL STRUCTURAL HARDWARE

- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
- B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
- C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.
 - a. Amscot Structural Products Corp.

2.06 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.07 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 - 4. Mark and match-mark materials for field assembly.
- 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/D1.1M.
- C. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- D. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.
- E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate 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.

2.08 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.09 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 - 2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.

- c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
4. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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 on Drawings.

3.03 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are 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.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.05 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

3.06 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 1. See Construction Drawings for Special Instruction requirements.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.
 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes, but is not limited to, the following:
 - 1. Steel tube framework for support of metal panels on observation tower including the following:
 - a. Attachment of framework to structural supporting steel structure.
 - b. Integration and support for perforated metal wall panel system
 - 2. Steel framing and supports for sectional doors, mechanical and electrical equipment.
 - 3. Loose steel lintels.
 - 4. Loose bearing and leveling plates.
 - 5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
- B. Related Sections:
 - 1. Section 05 12 00 – Structural Steel Framing
 - 2. Section 07 42 63 – Fabricated Wall Panel Assemblies
 - 3. Section 09 91 00 – Painting
 - 4. Section 09 96 00 – High Performance Coatings

1.02 ACTION SUBMITTALS

- A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: For the following:
 - 1. Paint products
 - 2. Grout
- C. Submit shop drawings that indicate fabrication, assembly and erection details, size of members, profiles, fastenings, supports and anchors, patterns, clearances and/or connections to other work.
- D. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Steel tube framework for support of metal panels on observation tower.
 - 2. Steel framing and supports for mechanical and electrical equipment.
 - 3. Steel framing and supports for applications where framing and supports are not specified in other Sections.

1.03 QUALITY ASSURANCE

- A. Welding Qualifications: 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."
- B. Fabricator Qualifications: A firm experienced in producing metal fabrications 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.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver steel members clearly marked and bundled.
- B. Store off ground, protect from standing water, and ventilate to prevent condensation.

1.05 FIELD CONDITIIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1.06 COORDINATION

- A. 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.
- B. Coordinate installation of metal fabrications that are anchored to 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.

PART 2 – PRODUCTS

2.01 METALS

- A. Steel Tubing: ASTM A500 Grade C (Fy = 50 ksi); minimum wall thickness per delegated design.
- B. Steel Shapes and Plates: ASTM A36 or ASTM A572 Grade 50.
- C. Structural Bolts: ASTM A325 or A490.
- D. Panel Attachment Hardware: Stainless steel, ASTM F593.'

2.02 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. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.
- D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Wood Screws: Flat head, ASME B18.6.1.
- G. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- H. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- I. Anchors, General: Anchors capable of sustaining, 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.
- J. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.03 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 for regalvanizing welds in steel, complying with SSPC-Paint 20.

- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.04 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. 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. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. 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.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.05 STEEL TUBE FRAMEWORK ON OBSERVATION TOWER

- A. Provide the structural steel tube framework designed as both an architectural feature and a supporting sub-structure for the perforated metal wall panel system. The framework shall be engineered to withstand applicable structural loads, wind loads, and imposed loads from the attached panel system, while contributing to the aesthetic design of the observation tower. Refer to Section 07 42 63 for delegated design requirements. Refer to Section 09 96 00 for coating requirements.
- B. Attachment to Structural Frame:
 - 1. Primary tube framework shall be connected directly to the observation tower's structural steel frame using bolted or welded connections as detailed.
 - 2. Provide base plates, clip angles, or knife plates shop-welded to tubes for field-bolting to tower structure.
 - 3. Allow for erection tolerances per AISC Code of Standard Practice.
 - 4. All fasteners exposed to exterior shall be stainless steel with tamper-resistant heads where accessible to public.
- C. Perforated Metal Wall Panel Support:
 - 1. Structural tube framework shall be designed to receive perforated metal wall panels.

2. Attachment system shall allow for thermal movement of panels while maintaining secure connection.
3. Panel anchors shall be stainless steel, non-corrosive, and concealed where possible.

2.06 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. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 1. Furnish inserts if units are installed after concrete is placed.

2.07 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. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Lintel Schedule: Furnish lintels for installation in Division 04 sections not furnished in Division 05 Section "Structural Steel Framing". Provide quantity and sizes indicated on Drawings or as indicated below if not indicated on Drawings.
 1. Where lintels occur in exterior wall assemblies, provide minimum lintel thickness of 5/16-inch.
 2. Set lintels with long leg vertical and with 8-inches of bearing each end.

2.08 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.
- C. Prime plates with zinc-rich primer.

2.09 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. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- B. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
 3. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- C. 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 zinc-rich primer is indicated.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates, supporting structure and installation conditions. Do not proceed with metal fabrication installation until unsatisfactory conditions have been corrected.
- B. Installation constitutes acceptance of existing conditions and responsibility of satisfactory performance.

3.02 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates and instructions for installation of anchorages which are required to be cast into concrete or embedded in masonry construction.

3.03 INSTALLATION, GENERAL

- A. Provide anchorage devices and fasteners necessary for securing metal fabrications to in-place construction.
 - 1. Conceal fasteners whenever possible.
 - 2. Secure metal to wood with lag screws of adequate size, with appropriate washers.
 - 3. Secure metal to concrete with embedded anchors, sleeves, setting components or setting grout.
 - 4. Use expansion bolts, toggle bolts or screws for light duty service only.
 - 5. Provide all fabricated items complete with attachment devices required for installation.
- B. Perform cutting, drilling and fitting required for installation of metal fabrications. Set work accurately in location, alignment and elevation, plumb, level true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.
- C. Fit exposed connections accurately together to form hairline joints. Weld connections which are not to be left as exposed joints. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dipped galvanized after fabrication and are intended for bolted or screwed field connections.
- D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made and methods used in correcting welding work.
- E. 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.
- F. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.04 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 securely to and rigidly brace from building structure. Provide continuous trim, do not field splice sill or head pieces.

3.05 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 05 51 13
EXTERIOR STEEL WINDER STAIR

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes fabrication and installation of exterior steel winder stair systems including:
 - 1. Stringers, treads, risers
 - 2. Landings and platforms
 - 3. Connections and anchorage.
- B. Related Sections:
 - 1. Section 05 12 00 – Structural Steel Framing.
 - 2. Section 05 52 00 – Exterior Railings
 - 3. Section 09 96 00 – High Performance Coatings: Paint finish for stairs.

1.02 REFERENCES

- A. NAAMM AMP 500 Series – Metal Stairs: Fabrication and Installation Guidelines
- B. ASTM – American Society for Testing and Materials:
 - 1. ASTM A36/A36M – Carbon Structural Steel
 - 2. ASTM A123/A123M – Zinc (Hot-Dip Galvanized) Coatings
 - 3. ASTM A992 – Structural Steel Shapes
- C. AWS – American Welding Society:
 - 1. AWS D1.1 – Structural Welding Code – Steel

1.03 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal stairs capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each component of metal stairs.
 - 1. Treads and Platforms of Metal Stairs: Capable of withstanding a uniform load of 100 lbf/sq. ft. or a concentrated load of 300 lbf on an area of 4 sq. in. whichever produces the greater stress.
 - 2. Stair Framing: Capable of withstanding stresses resulting from loads specified above in addition to stresses resulting from railing system loads.
 - 3. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

1.04 SYSTEM DESCRIPTION

- A. Design Requirements: Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, and profiles of units.
 - 1. Fabricator: Responsible for designing system, including necessary modifications to meet specified requirements and maintain visual design concepts.
 - 2. Employ registered professional engineer, licensed to practice structural engineering in jurisdiction where Project is located, to engineer each component of stair system.
 - 3. Make modifications only to meet field conditions and ensure fitting of components.
 - 4. Obtain Architect's approval of modifications and for connections to building elements at locations other than indicated on Drawings.
 - 5. Provide concealed fastening wherever possible.
 - 6. Attachment Considerations: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between units and building structure or between components themselves.

1.05 ACTION SUBMITTALS

- A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures.
 - 1. Submit Section 05 52 13 submittals simultaneously with submittals for this section.
- B. Shop Drawings: Show fabrication and installation details for metal stairs. Include plans, elevations, sections, and details of metal stairs including tread sizes and geometry, and connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.
 - 1. 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.

1.06 INFORMATIONAL SUBMITTALS

- A. Welding Certificates: Copies of certificates for welding procedures and personnel.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Arrange for metal stairs specified in this Section to be fabricated and installed by the same firm.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 - 1. Architectural Class.
- C. 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 metal stairs (including handrails and railing systems) that are similar to those indicated for this Project in material, design, and extent.
- D. Fabricator Qualifications: A firm experienced in producing metal stairs similar to those indicated for this Project and with a minimum of five years' experience in fabrication of steel stairs to NAAMM standards, as well as sufficient production capacity to produce required units.
- E. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.1, "Structural Welding Code--Steel."

1.08 COORDINATION

- A. Coordinate installation of anchorages for metal stairs. 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. Deliver such items to Project site in time for installation.
- B. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Metal Surfaces, General: Provide metal free from pitting, seam marks, roller marks, and other imperfections where exposed to view on finished units. Do not use steel sheet with variations in flatness exceeding those permitted by referenced standards for stretcher-leveled sheet.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Treads: Plank grating

- D. Steel Tubing: ASTM A500 or A501, as required for design loading and deflection.
- E. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- F. Uncoated, Cold-Rolled Steel Sheet: Commercial quality, complying with ASTM A 366/A 366M; or structural quality, complying with ASTM A 611, Grade A, unless another grade is required by design loads.
- G. Fasteners: Provide zinc-coated fasteners for exterior use or where built into exterior walls.
- H. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A47/A47M, or cast steel, ASTM A27/A27M. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A153.

2.02 STEEL TREADS AND RISERS

- A. Basis of Design:
 - 1. McNichols Company
 - a. Plank Grating, GRIP STRUT® Stair Tread Plank, galvanized steel, 14 gauge.
 - b. Width: 10-1/2 inches nominal depth to fit winder stair geometry.
 - c. Length/Shape: Fabricated to fit pie-shaped geometry of exterior steel winder stair.
 - d. Surface: Serrated diamond openings for maximum slip resistance.
 - e. Finish: Hot-dip galvanized, ASTM A123.
 - 2. Perforated Metal Riser Panels.
 - a. Perforated Metal: McNichols 1/2" Dia hole on 11/16" Stg. Centers. Item No. 1812613141. Furnish with U-edging.
 - b. Product Type: Round hole
 - c. Material: 3/16 inch, Type 304 Stainless Steel
 - d. Hole Size: 0.500
 - e. Hole Centers: 0.6875
 - f. Hole Pattern: Staggered
 - g. Straight Rows: Position horizontally
- B. Alternate manufacturers shall provide products meeting or exceeding performance requirements and dimensions indicated.

2.03 SURFACE PREPARATION AND APPLICATION

- A. Steel Surfaces to be Primed: Dry and free of dirt, oils, rust, salt and other contaminants.
 - 1. Blast-clean steel to SSPC SP-6 Commercial Grade for general use.
 - 2. Apply primers in accordance with manufacturer's instructions.

2.04 FASTENERS

- A. General:
 - 1. Ferrous Metal Items: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
 - 2. Aluminum and Stainless-Steel Items: Type 304 stainless-steel fasteners.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below 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. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).

2.05 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding, unless otherwise indicated.
 - 2. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 - 1. Architectural Class, for custom design units.
 - 2. Use channel stringers, plate will not be acceptable.
- C. Shop Assembly: Preassemble stairs in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Shear and punch metals cleanly and accurately. Remove sharp or rough areas on exposed surfaces.
- E. Weld connections 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. Weld exposed corners and seams continuously to exclude moisture.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- G. Fabricate stair treads to match geometry of winder stair, with tapered (pie-shaped) configuration.
- H. Provide carrier angles or end plates factory-welded to treads for secure anchorage to stringers.
- I. Riser-to-Tread Connection (Shop Welded):
 - 1. Fabricate perforated riser panels as an integral assembly with stair treads.
 - 2. Shop-weld riser panels to underside of GRIP STRUT treads directly behind nosing and at back edge of tread plank.
 - 3. Grind exposed welds smooth; remove burrs and sharp edges.
 - 4. Perform all welding prior to hot-dip galvanizing.
- J. Form risers from perforated metal panels, fitted to follow winder stair geometry.
 - 1. Provide perforated riser panels attached to the underside of the GRIP STRUT tread behind the nosing and to the back edge of tread plank.
 - 2. Connection may be continuous weld, plug weld, or bolted fastening, concealed from walking surface, as indicated on approved shop drawings.
 - 3. Ensure smooth transition between tread nosing and riser face with no exposed sharp edges.
- K. Provide shop welds in accordance with AWS D1.1. Grind smooth exposed welds.
- L. Provide weep holes in all hollow sections before galvanizing.

2.06 STEEL FRAMED STAIRS

- A. Stair Framing:
 - 1. Fabricate stringers of structural-steel channels as indicated.
 - 2. Provide closures for exposed ends of stringers.
 - 3. Construct landing platforms of structural-steel channel headers and miscellaneous framing members as indicated.
 - 4. Bolt or weld headers to stringers; bolt or weld framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.

2.07 FINISHES

- A. Comply with NAAMM'S "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Hot-Dip Galvanizing:
 - 1. All stair components (treads, risers, stringers, supports, connections, fasteners) shall be hot-dip galvanized after fabrication per ASTM A123 and ASTM A153.
- C. Paint metal stairs after assembly. Paint all exposed components including fastener heads.
- D. Shop Priming:
 - 1. Clean, pretreat, and apply manufacturer's standard primer.
 - 2. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer compatible with substrate and field-applied coatings despite prolonged exposure.
- E. Provide final painting under Section 09 96 00 – High Performance Coatings.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine conditions and proceed with Work in accordance with Section 01 73 00 – Execution.

3.02 PREPARATION

- A. Coordinate setting drawings, diagrams, templates and directions for installation of inserts and anchors, anchor bolts and miscellaneous items having integral anchors embedded in concrete.
 - 1. Coordinate and furnish inserts and anchors set in concrete for installation of work.
 - 2. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly of units. Disassemble units only as necessary for shipping and handling. Mark units for re-assembly and coordinated installation.

3.03 METAL STAIR INSTALLATION

- A. Install steel winder stair assemblies plumb, level, and true to line.
- B. Secure treads and risers to stringers with welded or bolted connections per approved shop drawings.
- C. Install perforated metal risers tight against the back of tread plank and directly behind GRIP STRUT nosing. Ensure secure connection as detailed in shop drawings to prevent vibration, deflection, or rattling.
- D. In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete inserts, through-bolts, lag bolts, and other connectors.
 - 1. Install stairs with flush alignment to in-place construction, no lipping of walking surfaces.
- E. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.
- F. Install metal stairs by welding stair framing to steel structure, unless otherwise indicated.
- G. 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.
- H. 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.

3.04 ADJUST AND CLEAN

- A. Immediately after erection, clean field welds, bolted connections and damaged shop coat, and re-coat.

END OF SECTION

SECTION 05 52 13
EXTERIOR RAILINGS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Decorative metal railings and guards.
 - 2. Perforated steel infill panels at stair and guardrail assemblies
- B. Related Section:
 - 1. Section 05 51 13 – Exterior Steel Winder Stair
 - 2. Division 26 – Linear LED lighting on railing

1.02 ACTION SUBMITTALS

- A. Prepare and submit the following submittals in accordance with Section 01 33 00 – Submittal Procedures:
- B. Product Data: For the following:
 - 1. Mechanically connected railing components.
 - 2. Railing brackets.
 - 3. McNichols perforated steel infill panels, including perforation pattern, material thickness, and finish.
- C. Shop Drawings: Submit shop drawings indicating fabrication and installation of pipe and tube railings with perforated metal infill. Include plans, elevations, sections, component details, and attachments to other work.
- D. 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.
- E. Qualification Data: For qualified professional engineer.

1.03 PERFORMANCE REQUIREMENTS

- A. General: Engineer handrails, railings, and perforated metal infill panels to withstand structural loads indicated.
- B. Structural Performance of Handrails and Guards: Provide assemblies capable of withstanding the following loads without exceeding allowable stresses:
 - 1. Stair Handrails and Guards:
 - a. Uniform load of 200 pounds per linear foot (plf) applied in any direction along the top rail.
 - b. Concentrated load of 200 pounds applied at any point in any direction.
 - 2. Top Landing Guardrail and Handrail:
 - a. Uniform load of 500 pounds per linear foot (plf) applied in any direction along the top rail.
 - b. Concentrated load of 500 pounds applied at any point in any direction.
 - 3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf applied to 1 sq. ft. at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
 - a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guards.
 - 4. Design railings and supports to transfer applied loads to structure without exceeding allowable stresses for materials and fasteners.

- C. Exterior Metal Fabrications: All exterior pipe and tube railings shall be fabricated and installed to prevent buckling, opening up of joints and overstressing of welds and fasteners under the following temperature conditions:
 - 1. Base fabrication on a temperature of +70 degrees F. at time of installation with allowance made for an exposed metal surface temperature range of -5 degrees F. to +180 degrees F. Make all necessary adjustments and provisions for concealed expansion.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 QUALITY ASSURANCE

- A. Fabricator/Installer Qualifications: A firm experienced in producing handrails and railings similar to those indicated for this Project for a minimum of 5 years, with a record of successful in-service performance, with sufficient production capacity to produce required units without causing delay in the work.
 - 1. Employ only experienced tradesmen for both fabrication and installation, who are capable of producing this work.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.05 DELEGATED DESIGN

- A. Delegated Design Responsibilities:
 - 1. Design, engineer, and detail perforated metal infill panels and their connection assemblies, including:
 - a. Panel geometry, thickness, and edge reinforcement as required.
 - b. Tabs or brackets welded/attached to railing posts.
 - c. Bolted connections between panels and tabs.
 - 2. Delegated design shall be performed by a Professional Engineer licensed in the Project jurisdiction, experienced in guard and railing systems.
- B. Submittals:
 - 1. Signed and sealed structural design calculations verifying compliance with performance requirements.
 - 2. Shop drawings showing panel profiles, thickness, edges, finish, connection tab details, bolt specifications, and installation sequence.
 - 3. Samples of panel material and finish, minimum 12 in. square.

1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating handrails and railings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.07 COORDINATION AND SCHEDULING

- A. 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.

- B. 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.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Infill Panels:
 - 1. Basis of Design: McNichols perforated steel panels.

2.02 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 type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished surfaces.

2.03 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, 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/A 36M.

2.04 INFILL PANELS

- A. Panel Description:
 - 1. Material: Steel perforated panels, McNichols or approved equal.
 - 2. Shape: As required for stair geometry.
 - 3. Perforation Pattern: Architect-selected from McNichols product line, designated on drawings.
 - 4. Thickness: As determined by delegated design.
 - 5. Edges: Returned flanges, stiffeners, or frame edges as required for strength and safety.
- B. Finish:
 - 1. Shop-prepared for exterior application.
 - 2. Receive shop-applied high-performance paint system, color selected by Architect.

2.05 INFILL PANEL CONNECTION COMPONENTS

- A. Tabs/Brackets:
 - 1. Material: Steel plate ASTM A36, thickness per delegated design engineer.
 - 2. Attachment to posts: Shop-welded or field-welded in compliance with AWS D1.1.
- B. Fasteners:
 - 1. Bolts, nuts, and washers: ASTM A307 galvanized, or stainless steel ASTM F593/F594.
 - 2. Lock washers or prevailing-torque lock nuts to resist loosening.

2.06 FASTENERS

- A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
2. Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
3. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.07 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 1. For railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- 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. Coating System: Comply with Section 09 96 00 – High Performance Coatings for system on handrails, guards, rails and other components indicated.

2.08 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 and clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- 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 may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. 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. At exposed connections, finish exposed surfaces to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.
 2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 3. Obtain fusion without undercut or overlap.
 4. Remove flux immediately.
 5. Weld exposed corners and seams continuously unless otherwise indicated.
- H. Form Changes in Direction as Follows:
 1. By bending or by inserting prefabricated elbow fittings.
- I. For changes in direction made by bending, use 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.
- J. Close exposed ends of railing members with prefabricated end fittings.
- K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 1. At brackets and fittings fastened to gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify railing posts are plumb, aligned, and securely anchored. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Install railing and infill panel assemblies in accordance with approved delegated design submittals, manufacturer's instructions, and contract documents.
- B. Bolt perforated panels securely to welded tabs; torque fasteners per design requirements
- C. Ensure tight-fitting installation, proper alignment, and absence of rattling or vibration.
- D. Ensure panels are tight-fitting, properly aligned, and free of rattling or vibration.
- E. Tolerances:
 - 1. Panel alignment: $\pm 1/8$ inch (3 mm) in any direction.
 - 2. Gap between panels and posts: $1/8$ inch (3 mm) maximum.
- F. Fit railing components exposed connections together to form tight, hairline joints.
- G. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of $1/16$ inch in 3 feet (2 mm in 1 m).
 - 3. 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 (6 mm in 3.5 m).
- H. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- I. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.03 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with AWS requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- B. 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 (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.04 ANCHORING POSTS AND GUARDS

- A. Stair posts are welded directly to the top flange of steel stair stringers with full-penetration welds.
- B. Ensure all welded connections are ground smooth and free of slag, undercut, or defects; finish per NOMMA Type 2 standards.
- C. Provide continuous full-penetration welds at all contact points between posts and stringer flanges, ensuring structural integrity and load transfer.
- D. Design welds to resist all applied vertical, horizontal, and lateral loads, including handrail and guard loads, wind, and potential impact loads.
- E. Apply protective coatings to welded areas consistent with shop-applied primer and intermediate coatings specified in Section 09 96 00.

3.05 ADJUSTING AND CLEANING

- A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.06 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.

END OF SECTION

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Wood products.
 - 2. Wood-preservative-treated lumber.
 - 3. Dimension lumber framing.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.
 - 2. Section 061753 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.

1.02 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. Lumber grading agencies, and abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. SPIB: The Southern Pine Inspection Bureau.
 - 4. WCLIB: West Coast Lumber Inspection Bureau.
 - 5. WWP: Western Wood Products Association.

1.03 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.
 - 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.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS

- A. Maximum Moisture Content:
 - 1. Boards: 19 percent.

2. Dimension Lumber: 19 percent unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1, Use categories as follows:
 1. UC3B (Commodity Specification A): Uncoated sawn products in exterior construction not in contact with ground, exposed to all weather cycles including intermittent wetting but with sufficient air circulation for wood to dry. Excludes sawn products not in contact with ground but with ground contact-type hazards. Include all rough carpentry. the following items:
 - a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - b. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
 - c. Wood decking, railings, and joists and beams for decks that are not critical to the performance and safety of the entire system/construction and that are in locations easily accessible for maintenance, repair, or replacement.
 2. 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 that does not comply with requirements for untreated material.
- C. Application: Treat all rough carpentry unless otherwise indicated. items indicated on Drawings, and the following:

2.03 DIMENSION LUMBER FRAMING

- A. Joists, Rafters, and Other Framing by Grade: No. 1 grade.
 1. Species:
 - a. Hem-fir (north); NLGA.
 - b. Douglas fir-larch; WCLIB or WWP A.
 - c. Southern pine or mixed southern pine; SPIB.
 - d. Spruce-pine-fir; NLGA.
 - e. Douglas fir-south; WWP A.
 - f. Hem-fir; WCLIB or WWP A.
 - g. Douglas fir-larch (north); NLGA.
 - h. Spruce-pine-fir (south); NeLMA, WCLIB, or WWP A.
- B. Joists, Rafters, and Other Framing by Performance: Any species and grade with a modulus of elasticity of at least 1,500,000 psi 1,300,000 psi 1,100,000 psi 1,000,000 psi 900,000 psi and an extreme fiber stress in bending of at least 1000 psi 850 psi 700 psi 600 psi 500 psi for 2-inch nominal thickness and 12-inch nominal width for single-member use.

2.04 MISCELLANEOUS LUMBER

- A. 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.
 4. Cants.
 5. Furring.
 6. Grounds.
 7. Utility shelving.
- B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of any of the following species:
 1. Hem-fir (north); NLGA.
 2. Mixed southern pine or southern pine; SPIB.
 3. Spruce-pine-fir; NLGA.
 4. Hem-fir; WCLIB or WWP A.

5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

- C. 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.
- D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.05 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. Where rough 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 A153/A153M or ASTM F2329 of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.06 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. MiTek Industries, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. Tamlyn.
- B. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch- minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.
- C. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
 - 1. Width: 3/4 inch 1-1/4 inches.
 - 2. Thickness: 0.050 inch 0.062 inch.
 - 3. Length: 16 inches 24 inches As indicated.
- D. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. Tie fastens to side of rafter or truss, face of top plates, and side of stud below.
- E. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches wide by 0.062 inch thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- F. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.
- G. Do not splice structural members between supports unless otherwise indicated.
- H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- I. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
- J. Sort and select lumber so that natural characteristics do 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.
- K. Comply with AWPAC 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.
- L. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- M. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
- N. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.02 INSTALLATION OF WOOD BLOCKING AND NAILERS

- 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 wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

- C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.
- D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.03 INSTALLATION OF WOOD FURRING

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.04 INSTALLATION OF FLOOR JOIST FRAMING

- A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:
 - 1. Where supported on wood members, by using metal framing anchors.
 - 2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.
- B. Fire Cuts: At joists built into masonry, bevel cut ends 3 inches and do not embed more than 4 inches.
- C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches.
- D. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than one-third depth of joist; do not locate closer than 2 inches from top or bottom.
- E. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.
- F. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches or securely tie opposing members together. Provide solid blocking of 2-inch nominal thickness by depth of joist over supports.
- G. Anchor members paralleling masonry with 1/4-by-1-1/4-inch metal strap anchors spaced not more than 96 inches o.c., extending over and fastening to three joists. Embed anchors at least 4 inches into grouted masonry with ends bent at right angles and extending 4 inches beyond bend.
- H. Provide solid blocking between joists under jamb studs for openings.
- I. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.
 - 1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.

3.05 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.

END OF SECTION

SECTION 061300

HEAVY TIMBER CONSTRUCTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Timber.

1.02 DEFINITIONS

- A. Timbers: Lumber of 5 inches nominal or greater in least dimension.
- B. Inspection 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: Southern Pine Inspection Bureau (The).
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Schedule delivery of materials to avoid extended on-site storage and to avoid delaying the Work.
- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.01 TIMBER

- A. Comply with DOC PS 20 and with grading rules of lumber-grading agencies certified by ALSC's Board of Review as applicable.
 - 1. Factory mark each item of timber with grade stamp of grading agency.
 - 2. For exposed timber indicated to receive a stained or natural finish, apply grade stamps to surfaces that are not exposed to view, or omit grade stamps and provide certificates of grade compliance issued by grading agency.
- B. Structural Properties: Provide any species and grade that, for moisture content provided, complies with required structural properties.
 - 1. Allowable Stress Ratings for 12-Inch Nominal Depth: Fb 1500 psi and E 1,500,000 psi.

2.02 TIMBER CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. Halfen Anchoring Systems.
 - 3. Simpson Strong-Tie Co., Inc.
 - 4. USP Structural Connectors.
- B. Fabricate beam seats from steel with 3/8-inch bearing plates, 3/4-inch- diameter-by-12-inch- long deformed bar anchors, and 0.239-inch side plates.
- C. Fabricate beam hangers from steel with 0.179-inch stirrups and 0.239-inch top plates.

- D. Provide bolts, 3/4 inch unless otherwise indicated, complying with ASTM A307, Grade A; provide nuts complying with ASTM A563; and, where indicated, provide flat washers.
- E. Materials: Unless otherwise indicated, fabricate from the following materials:
 - 1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
 - 2. Round steel bars complying with ASTM A575, Grade M 1020.
 - 3. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade 33.
 - 4. Stainless steel plate, sheet, and strip complying with ASTM 240/A240M or ASTM A666, Type 304.
 - 5. Stainless steel flat bars complying with ASTM A666, Type 304.
 - 6. Stainless steel bars and shapes complying with ASTM A276, Type 304.
- F. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.
- G. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A123/A123M or ASTM A153/A153M.

2.03 FABRICATION

- A. Shop fabricate members by cutting and restoring exposed surfaces to match specified surfacing. Finish exposed surfaces to remove planing or surfacing marks, and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
- B. Predrill for fasteners and assembly of units.
- C. Where preservative-treated members are indicated, fabricate (cut, drill, surface, and sand) before treatment to greatest extent possible. Where fabrication must be done after treatment, apply a field-treatment preservative to comply with AWP A M4.
 - 1. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
- D. Coat crosscuts with end sealer.
- E. Seal Coat: After fabricating and surfacing each unit, apply a saturation coat of penetrating sealer on surfaces of each unit except for treated wood where the treatment included a water repellent.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Erect heavy timber framing true and plumb. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
 - 1. Install horizontal and sloping members with crown edge up, and provide not less than 4 inches of bearing on supports. Provide continuous members unless otherwise indicated; tie together over supports with metal strap ties if not continuous.
 - 2. Handle and temporarily support heavy timber framing to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Framing Built into Masonry: Provide 1/2-inch clearance at tops, sides, and ends of members built into masonry, and bevel cut ends 3 inches; do not embed more than 4 inches unless otherwise indicated.
- C. Fitting: Fit members by cutting and restoring exposed surfaces to match specified surfacing.
 - 1. Predrill for fasteners using timber connectors as templates.
 - 2. Finish exposed surfaces to remove planing or surfacing marks, and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
 - 3. Coat crosscuts with end sealer.
 - 4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWP A M4.
 - a. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.

- b. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
- D. Install timber connectors as indicated.
 - 1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
 - 2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.02 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged heavy timber framing if repairs are not approved by Architect.

END OF SECTION

SECTION 061516
WOOD ROOF DECKING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Glue-laminated wood roof decking.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For glued-laminated wood roof decking, include installation instructions and data on lumber, adhesives, and fabrication.
 - 2. For preservative-treated wood products, include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

1.03 INFORMATIONAL SUBMITTALS

- A. Research/Evaluation Reports: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, from ICC-ES.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Schedule delivery of wood roof decking to avoid extended on-site storage and to avoid delaying the Work.
- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings. Stack wood roof decking with surfaces that are to be exposed in the final Work protected from exposure to sunlight.

PART 2 - PRODUCTS

2.01 WOOD ROOF DECKING, GENERAL

- A. General: Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

2.02 GLUED-LAMINATED WOOD ROOF DECKING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Structural Wood Systems; A Division of Harrison Industries.
- B. Face Species: Douglas fir-larch or Douglas fir-larch (North).
- C. Roof Decking Nominal Size: 2 by 6.
- D. Roof Decking Configuration: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, provide tongue-and-groove configuration that complies with research/evaluation report.
- E. Face Grade:
 - 1. Custom or Supreme: Clear face is required. Occasional pieces may contain a small knot or minor characteristic that does not detract from the overall appearance.
- F. Moisture Content: Provide wood roof decking with 15 percent maximum moisture content at time of dressing.

- G. Face Surface: Smooth.
- H. Edge Pattern: Beaded edge.
- I. Laminating Adhesive: Wet-use type complying with ASTM D2559.

2.03 PRESERVATIVE TREATMENT

- A. Pressure treat wood roof decking in accordance with AWWPA U1; Use Category UC2.
 - 1. For laminated roof decking, treat lumber before gluing.
- B. Preservative Chemicals: Inorganic boron (SBX) Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 1. For exposed items indicated to receive a stained or natural finish, use products that do not contain colorants, bleed through, or otherwise adversely affect finishes.
- C. After treatment, redry materials to 19 percent maximum moisture content.

2.04 ACCESSORY MATERIALS

- A. Fasteners for Glued-Laminated Roof Decking: Provide fastener size and type complying with requirements in "Installation" Article for installing laminated roof decking.
- B. Nails: Common; complying with ASTM F1667, Type I, Style 10.
- C. Fastener Material: Hot-dip galvanized steel.
- D. Sealants: Latex, complying with applicable requirements in Section 079200 "Joint Sealants" and recommended by sealant manufacturer and manufacturer of substrates for intended application.
- E. Penetrating Sealer: Clear sanding sealer complying with Section 099300 "Staining and Transparent Finishing" and compatible with topcoats specified for use over it.

2.05 FABRICATION

- A. Shop Fabrication: Where preservative-treated roof decking is indicated, complete cutting, trimming, surfacing, and sanding before treating.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine walls and support framing in areas to receive wood roof decking for compliance with installation tolerances and other conditions affecting performance of wood roof decking.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install laminated wood roof decking to comply with manufacturer's written instructions.
 - 1. Locate end joints for lay-up indicated.
 - 2. Nail each course of glued-laminated wood roof decking at each support with one nail slant nailed above the tongue and one nail straight nailed through the face.
 - a. Use 12d nails for 2-by-6 and 2-by-8 roof decking.
- B. Apply joint sealant to seal roof decking at exterior walls at the following locations:
 - 1. Between roof decking and supports located at exterior walls.
 - 2. Between roof decking and exterior walls that butt against underside of roof decking.
 - 3. Between tongues and grooves of roof decking over exterior walls and supports at exterior walls.

3.03 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged roof decking if repairs are not approved by Architect.

3.04 PROTECTION

- A. Provide water-resistive barrier over roof decking as the Work progresses to protect roof decking until roofing is applied.
- B. If, despite protection, inorganic boron (SBX)-treated roof decking becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 061600

SHEATHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Roof sheathing.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for plywood backing panels.

1.02 ACTION SUBMITTALS

- A. Product Data:
 - 1. Roof sheathing.

1.03 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.04 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.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PANEL PRODUCTS

- A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- B. Factory mark panels to indicate compliance with applicable standard.

2.02 ROOF SHEATHING

- A. Plywood Sheathing, Roofs: Either DOC PS 1 or DOC PS 2, Exterior Exposure 1, Structural I sheathing.
 - 1. Span Rating: Not less than 32/16.
 - 2. Nominal Thickness: Not less than 15/32 inch.
- B. Oriented-Strand-Board Sheathing, Roofs: DOC PS 2, Exposure 1, Structural I sheathing.
 - 1. Span Rating: Not less than 32/16.
 - 2. Nominal Thickness: Not less than 7/16 inch.

2.03 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
- G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

2.04 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

2.05 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. 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.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate roof 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.

3.02 FIELD QUALITY CONTROL

- A. Testing and Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier and water-resistant glass-mat gypsum sheathing, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 - 3. Termination mastic has been applied on cut edges.
 - 4. Strips and transition strips have been firmly adhered to substrate.
 - 5. Compatible materials have been used.
 - 6. Transitions at changes in direction and structural support at gaps have been provided.
 - 7. Connections between assemblies (sheathing and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 8. All penetrations have been sealed.
- C. Air barriers will be considered defective if they do not pass tests and inspections.
- D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- E. Prepare test and inspection reports.

END OF SECTION

SECTION 061753

SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.01 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.02 ACTION SUBMITTALS

- A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plant that treated materials comply 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 from treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.
- B. Shop Drawings: Show fabrication and installation details for trusses.
 - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
 - 2. Indicate sizes, stress grades, and species of lumber.
 - 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
 - 4. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
 - 5. Show splice details and bearing details.
- C. Delegated Design Submittals: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.03 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.
- B. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.
- C. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated lumber.
 - 2. Fire-retardant-treated wood.
 - 3. Metal-plate connectors.
 - 4. Metal truss accessories.

1.04 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
 - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.

2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. 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.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Metal-plate-connected wood trusses are to be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 1. Design Loads: As indicated.
 2. Maximum Deflection under Design Loads:
 - a. Roof Trusses: Vertical deflection of 1/180 of span.
- C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.02 WOOD PRODUCTS

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (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. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
 3. Provide dressed lumber, S4S.
 4. Provide dry lumber with 15 percent maximum moisture content at time of dressing.
- B. Minimum Chord Size for Roof Trusses: 2 by 6 inches nominal for top chords.
- C. Minimum Specific Gravity for Top Chords: 0.50.
- D. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

2.03 METAL CONNECTOR PLATES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alpine Engineered Products, Inc.; a division of ITW Building Components Group, Inc.
 2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
 3. Eagle Metal Products.
 4. MiTek Industries, Inc.
- B. Fabricate connector plates to comply with TPI 1.
- C. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.
1. Use for interior locations unless otherwise indicated.

2.04 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
 2. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667.

2.05 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cleveland Steel Specialty Co.
 2. Phoenix Metal Products, Inc.
 3. Simpson Strong-Tie Co., Inc.
- B. Allowable design loads, as published by manufacturer, are to comply with or exceed those of products of manufacturers listed. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
1. Use for interior locations unless otherwise indicated.
- D. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
1. Use for exterior locations and where indicated.
- E. Truss Tie-Downs: Bent strap tie for fastening roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. Tie fastens to one side of truss, top plates, and side of stud below.

2.06 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.07 FABRICATION

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
 - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

2.08 SOURCE QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections.
 - 1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
 - 2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.
- B. Correct deficiencies in Work that special inspections indicate do not comply with the Contract Documents.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
 - 1. Install bracing to comply with Section 061000 "Rough Carpentry."
- I. Install wood trusses within installation tolerances in TPI 1.
- J. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- K. Replace wood trusses that are damaged or do not comply with requirements.
 - 1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.02 REPAIRS AND PROTECTION

- A. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Repair damaged galvanized coatings on exposed surfaces in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.03 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections to verify that temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

END OF SECTION

SECTION 06 73 00
COMPOSITE DECKING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes composite decking and accessories, including fasteners and trim pieces necessary for complete installation.
- B. Related Sections:
 - 1. Section 06 10 00 – Rough Carpentry.
 - 2. Section 05 50 00 – Metal Fabrications (for deck framing, supports, and rails where applicable).

1.02 ACTION SUBMITTALS

- A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data:
 - 1. Submit manufacturer's literature describing composite products to be provided. Include manufacturer's deck span charts and installation handbooks.
- C. Shop Drawings:
 - 1. Submit scaled shop drawings showing deck layout, anchoring sizes and types, member sizes and profiles, and other similar detailed information needed to fully describe fabrication and installation of decks.
 - 2. Shop drawings shall show adjacent or related Work.
 - 3. Shop drawings submittal shall be coordinated with shop drawings submission of related portions of Work:
- D. Verification Samples:
 - 1. Submit 3 samples of typical composite members illustrating finish color and texture of selected finish. Color samples shall be faded by exposure to weathering.
 - 2. Sample Size: 12 inch in length, 6 inch x 6 inch, or full size as appropriate to material

1.03 INFORMATIONAL SUBMITTALS

- A. Quality Assurance Submittals:
 - 1. Test Reports:
 - a. Submit test reports for prepared by an independent testing laboratory indicating full compliance with specified requirements.
 - 2. Certificates:
 - a. Submit manufacturer's certificate that products meet or exceed specified requirements and are suitable for intended application.
- B. Contract Close-out Submittals:
 - 1. Operation and Maintenance:
 - a. Submit instructions to be followed in cleaning and maintaining decking. Include a copy of instruction in Operation and Maintenance Data Manual; refer to Section 01 77 19.

1.04 QUALITY ASSURANCE

- A. Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity.
 - 1. Single Source Responsibility:

- a. Materials shall be products of a single manufacturer or items standard with composite manufacturer.
 - b. Provide secondary materials that are produced or are specifically recommended by composite manufacturer to ensure compatibility.
- B. Regulatory Requirements:
 - 1. Comply with Federal Accessibility Regulations:
 - a. Americans with Disabilities Act - ADA
 - b. Uniform Federal Accessibility Standards - UFAS

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prepackaged materials in manufacturer's original unopened packaging with labels intact. Packaging or containers shall fully identify brand, type, grade, class, and other qualifying information used to describe contents.
- B. Storage and Handling Requirements: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer.
 - 1. Immediately upon delivery to Site place materials in area protected from weather.
 - 2. Take special care when handling.
 - 3. Store composite lumber decking on a flat surface
 - 4. When stacking palletted units, start supports at each end and spaced 24 inch oc.
 - 5. Line up supports vertically.

1.06 WARRANTY

- A. Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
 - 1. Provide industry standard (top quality) manufacturer's fully transferable limited warranty against splintering, splitting, checking, rot, decay and termite damage.
 - 2. Warranty Period: 10 years beginning with Date of Substantial Completion

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Trex Company
- B. Materials specified herein are cited as minimum standard of quality that will be acceptable and shall not preclude consideration of equivalent or superior materials. Suggested substitutions by other manufacturers shall be submitted to Architect for consideration in compliance with substitution procedures in Section 01 25 00.

2.02 COMPOSITE LUMBER

- A. Material Description: Solid composite material consists of approximately 50 percent wood fibers by weight with remainder of material being a thermoplastic polymer plastic material
 - 1. Sizes: As indicated on Drawings
 - 2. Color: Refer to Schedule of Finishes
 - 3. Product: Trex - Wood Composite Lumber Decking
- B. Structural Properties: Ultimate value/design value (based on 2 x 6 cross section)
 - 1. Compression Parallel to Length; ASTM D198: 1806 psi/550 psi
 - 2. Compression Perpendicular to Length; ASTM D143: 1944 psi/625 psi
 - 3. Tensile Strength; ASTM D198: 854 psi/250 psi
 - 4. Shear Strength; ASTM D143: 561 psi/200 psi
 - 5. Modulus of Rupture; ASTM D4761: 1423 psi/250 psi
 - 6. Modulus of Elasticity; ASTM D4761: 175,000 psi/100,000 psi

C. Physical Properties:

1. Fire Resistance:
 - a. Flammability; ASTM E84; Flame Spread Index: 80
 - b. Smoke Developed Index: 285
 - c. Self-Ignition Temperature; ASTM D1929: 743° F
 - d. Flash Ignition Temperature; ASTM D1929: 698° F
2. Water Absorption; ASTM D1037: (24 hour immersion)
 - a. Sanded Surface: 4.3 percent
 - b. Unsanded Surface: 1.7 percent
3. Abrasion Resistance; ASTM D2394: 0.01 inch wear/1000 revs
4. Hardness; ASTM D143: 1124 lbs.
5. Expansion/Contraction Properties:
 - a. Thermal Values (36 inch long samples):
 - 1) Width: 35.2 x 10⁻⁶ to 42.7 x 10⁻⁶
 - 2) Length: 16.1 x 10⁻⁶ to 19.2 x 10⁻⁶
 - b. Moisture Values for Long Term Water Immersion (36 inch long samples):
 - 1) Width -3 percent
 - c. Moisture Values for Constant High Humidity (6 inch long samples):
 - 1) Width -1 percent

2.03 ACCESSORIES

A. Provide nails, spikes, screws, clips, and bolts needed for proper installation of composite lumber decking. Sizes and quantities as needed by code authority having jurisdiction, unless more stringent requirements are indicated.

1. Bolts, Exterior Use:
 - a. Material Standard: ASTM A307, with standard washers
 - b. Finish: Galvanized, ASTM A123
 - c. Size: Diameter less than or equal to 1/2"
2. Lag Screws:
 - a. Material Standard: ANSI B18.2.1
 - b. Finish: Hot dipped galvanized for exterior use
3. Expansion Shields:
 - a. Material Standard: FS FF-S-325, Type 1, Group III, Self-drilling
4. Nails, General:
 - a. Material Standard: ASTM F1667
 - b. Type: Common unless otherwise indicated
 - c. Finish: Hot dipped galvanized for exterior use
 - d. Size: Nails shall have a diameter less than or equal to 16d common wire (0.162 inch diameter)
5. Wood Screws:
 - a. Material Standard: FS FF-S-111
 - b. Size: Screws shall have a diameter less than or equal to No. 12 (0.216 inch diameter)

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which construction of composite lumber decking shall be performed.
- B. Verify substrate is level, plumb, and capable of supporting decking loads.
- C. Confirm framing spacing complies with manufacturer's requirements. Correct conditions detrimental to timely and proper execution of Work.
- D. Do not proceed until unsatisfactory conditions have been corrected.
- E. Framing: Ensure that framing true, plumb and level.
 - 1. Provide temporary bracing as needed to maintain lines and levels until permanent members are in place.
 - 2. Install miscellaneous connectors, anchors and accessories as indicated and needed for a complete installation.

3.02 INSTALLATION – DECK BOARDS

- A. Install decking in accordance with manufacturer's written instructions.
- B. Orientation: Install boards with wood-grain side up unless otherwise indicated.
- C. Spans:
 - 1. Ensure decking spans do not exceed requirements of manufacturer's Decking Span Chart.
 - 2. Work in which boards are incorrectly spanned shall be rejected.
- D. Gapping: Ensure boards are gapped end-to-end and width-to-width as described in manufacturer's installation handbook.
 - 1. Use manufacturer's gapping guidelines to calculate end spacing.
 - 2. Use hidden fastener system at grooved boards.
 - 3. Work in which board is incorrectly gapped shall be rejected.
 - 4. Pre-drill and fasten square edge boards with manufacturer-approved fasteners.
 - 5. Install trim, fascia, and risers to provide finished appearance.
- E. Expansion Gaps:
 - 1. Provide minimum 1/8 inch gap between deck boards to allow for drainage.
 - 2. Provide minimum 1/4 inch gap where decking abuts walls, posts, or other vertical obstructions.
- F. Fastening:
 - 1. Grooved Edge Boards: Secure with Trex Hideaway® hidden fastener system.
 - 2. Square Edge Boards: Pre-drill and fasten with stainless steel, corrosion-resistant screws driven flush with surface.
 - 3. Provide two fasteners per joist at board ends.
- G. Alignment: Maintain consistent board spacing and alignment across deck surface.
- H. Cutting: Use carbide-tipped saw blades; cut ends square. Support boards fully during cutting.
- I. Sealing: No end-sealing required; factory shell finish provides moisture resistance.

3.03 FIELD QUALITY CONTROL

- A. Remove and replace decking that is damaged, warped, or improperly installed.

3.04 CLEANING

- A. Comply with cleaning instructions as described in manufacturer's installation handbook. Clean deck surface per manufacturer's maintenance recommendations.

3.05 PROTECTION

- A. Protect installed work from damage due to subsequent construction activity on-site until final completion.

END OF SECTION

SECTION 06 83 16
FIBERGLASS REINFORCED PANELING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Plastic ceiling panels.
 - 2. Associated PVC trim and accessories.
- B. Related Section:
 - 1. Section 09 29 00 – Gypsum Board.

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
 - 2. ASTM D4226 – Standard Test Method for Impact Resistance of Rigid Poly(Vinyl Chloride) (PVC) Building Products
 - 3. ASTM D696 – Coefficient of Linear Thermal Expansion of Plastics
 - 4. ASTM D792 – Density and Specific Gravity of Plastics
 - 5. ASTM D638 – Tensile Properties of Plastics
 - 6. ASTM G21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
 - 7. ASTM D5116 – Guide for Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide fiberglass reinforced plastic panels which have been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.04 ACTION SUBMITTALS

- A. Prepare and submit the following in accordance with Section 01 33 00 – Submittal Procedures:
- B. Product Data: Submit product data, including manufacturer's product sheet and installation instructions, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures. Indicate location and dimension of joints and fastener attachment.
- D. Samples: Submit selection and verification samples for finishes, colors and textures. Submit two samples of each type of panel, trim and fastener.
- E. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Products shall be installed by a single installer experienced in PVC ceiling panel installations.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Package sheets on skids or pallets for shipment to project site.
- C. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Store panels indoors in a dry place at the project site.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Installation shall not begin until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from concrete or other work has dissipated.
 - 2. During installation, and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
 - 3. Provide ventilation to disperse fumes during application of adhesive as recommended by adhesive manufacturer.
- B. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.08 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
 - 1. Warranty Period: 20 years commencing on Date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design Manufacturer/Product:
 - 1. Trusscore Inc. Wall & CeilingBoard
- B. The Basis of Design establishes the required standard of quality, performance, and appearance. Products by other manufacturers may be considered in accordance with Section 01 25 00 – Substitution Procedures, provided they demonstrate compliance with the requirements of this Section and maintain the design intent.

2.02 PERFORMANCE REQUIREMENTS

- A. Physical Performance:
 - 1. Impact Resistance: Min. 2.08 in-l/mil per ASTM D4226
 - 2. Coefficient of Thermal Expansion: Max. 5.7×10^{-5} in/in/°F per ASTM D696
 - 3. Density: 1.46 per ASTM D792
 - 4. Tensile Strength: Min. 6,575 psi per ASTM D638
- B. Surface-Burning Characteristics: ASTM E84 Class A, Flame Spread Index ≤ 25 , Smoke Developed ≤ 450
- C. Environmental Performance:
 - 1. Fungus Resistance: Pass, Growth Rating 0 per ASTM G21; boards contain no cellulosic material
 - 2. Waterproof and nonporous
 - 3. Corrosion-proof

2.03 PVC CEILING PANELS

- A. Basis-of-Design: Trusscore Wall & CeilingBoard (ceiling application)
 - 1. Tongue-and-groove, rib-reinforced PVC panels with nailing fins.

- 2. Sizes: 16 inches wide length required
- 3. Weight: 0.8 lbs./sq ft
- B. Color: Per Finish Legend on drawings.
- C. Accessories:
 - 1. Trusscore PVC Trims: Base trim, channel snap-In kit, inside cove corner, J trim, outside corner, as required for installation.
 - 2. Material: PVC
 - 3. Color: To match ceiling panels.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
 - 1. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails are countersunk and joints and cracks are filled flush and smooth with the adjoining surface.
 - 2. Do not begin installation until backup surfaces are in satisfactory condition.

3.02 PREPARATION

- A. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- C. Lay out paneling before installing. Locate panel joints where indicated.
 - 1. Mark plumb lines on substrate at trim accessory or panel joint locations for accurate installation.
 - 2. Locate trim accessories or panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.03 INSTALLATION

- A. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.
- B. Install perpendicular to framing; stagger end joints and install ceiling panels plumb, level, and square per manufacturer instructions. Install panels with manufacturer's recommended gap for panel field and corner joints
- C. Cutting Panels: Use fine-tooth or PVC saw; make straight, square cuts.
- D. Anchor with construction adhesive and corrosion-resistant fasteners. Do not over-tighten; fasteners must stay in nailing fin. Use products acceptable to panel manufacturer and install panels in accordance with panel manufacturer's printed instructions
- E. High Moisture Areas: Apply silicone in panel grooves; ensure proper drainage in trim piece.

3.04 CLEANING

- A. Cleaning: Remove temporary coverings, protective masking, and protection of adjacent work areas. Repair or replace products that have been installed and are damaged.
 - 1. Remove any adhesive or excessive sealant from panel face using solvent or cleaner recommended by panel manufacturer.
 - 2. Use a clean, damp, nonabrasive cotton cloth and a mild liquid detergent or household cleaner.
 - 3. Rinse with clean water using a clean, nonabrasive cotton cloth.
 - 4. Dry panels with a soft, clean nonabrasive cotton cloth.
 - 5. Do not use cleaners containing acid, alkali or sodium hypochlorite.

3.05 PROTECTION

- A. Protection: Protect installed product and finish surfaces from damage during construction.

END OF SECTION

SECTION 07 10 00
DAMPPROOFING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes water-based asphalt emulsion dampproofing for exterior below-grade concrete foundation walls.
- B. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete.
 - 2. Section 04 22 00 – Concrete Unit Masonry
 - 3. Section 07 21 00 – Thermal Insulation.
 - 4. Section 07 26 00 – Vapor Retarders.

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM D1227 – Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
 - 2. ASTM D41 – Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - 3. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
 - 4. ASTM D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

1.03 PERFORMANCE REQUIREMENTS

- A. Dampproofing Membrane Performance:
 - 1. Type: Cold-applied, water-based asphaltic emulsion.
 - 2. Solvent Content: Zero added solvents; shall not adversely affect extruded polystyrene insulation.
 - 3. VOC: ≤ 50 g/L.
 - 4. Application Temperature Range: ≥ 40 °F (5 °C) and rising.
 - 5. Service Temperature Range: –20 °F to 150 °F (–29 °C to 66 °C), minimum.
 - 6. Elongation: ≥ 100% at 73 °F (23 °C), ASTM D412.
 - 7. Adhesion to Concrete: ≥ 2.0 lbf/in (ASTM C794 or equivalent).
 - 8. Water Resistance: No water penetration at 10 ft head pressure for 24 hours.
 - 9. Water Vapor Permeability: ≥ 1 perm, ASTM E96, to allow substrate drying..

1.04 ACTION SUBMITTALS

- A. Prepare submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product data including data substantiating that materials comply with requirements for dampproofing material specified. Include recommended method of application, recommended primer, number of coats, coverage or thickness, and recommended protection course.
- C. Certificates: Written certification of compatibility with extruded polystyrene insulation.
- D. Test Reports: Independent lab reports verifying compliance with ASTM standards.
- E. Installer Qualifications: Documentation showing minimum 3 years' experience with dampproofing installations.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with National Roofing Contractors Association (NRCA) Waterproofing and Dampproofing Manual.

- B. Obtain primary dampproofing materials and primers from one source and by a single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- C. Applicator Qualifications: Company with minimum of 5 years' experience in application of specified products on projects of similar size and scope, and is acceptable to product manufacturer.

1.06 PROJECT CONDITIONS

- A. Proceed with dampproofing work only after substrate construction and penetrating work have been completed.
- B. Proceed with dampproofing only when existing and forecasted weather conditions will permit work to be performed according to manufacturer's recommendations and warranty requirements.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Water-based asphaltic dampproofing to foundation walls; product shall be solvent-free, ASTM D1227-compliant, and fully compatible with extruded polystyrene (XPS) insulation installed against cured surface.
- B. Acceptable Products (water-based asphaltic emulsions):
 - 1. Henry Company – Henry 107 Asphalt Emulsion Sealer & Dampproofer.
 - 2. W. R. Meadows – SEALMASTIC Emulsion Dampproofing (Types I, II, or III).
 - 3. Sika – Sikalastic 315 Waterborne Asphalt Emulsion.
 - 4. Mar-Flex – Water-Based Dampproofing Emulsion or DampFUSION.
- C. Substitutions: Allowed under provisions of Division 01, provided performance criteria are met.

2.02 MATERIALS

- A. Dampproofing Compound:
 - 1. Cold-applied, water-based asphalt emulsion.
 - 2. Cures to a flexible, continuous membrane.
 - 3. Shall be solvent-free, non-toxic, and non-flammable when wet.
 - 4. Black in color.
- B. Protection/Insulation Board: Extruded polystyrene insulation, ASTM C578, installed against cured dampproofing.

2.03 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
 - 1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
- B. Verify that surfaces to be dampproofed are in good repair, clean, and conform to dampproofing manufacturer's requirements.
- C. Verify items which penetrate surfaces to receive dampproofing are securely installed.
- D. Verify that environmental conditions at time of application are within parameters specified by dampproofing manufacturer.

3.02 PREPARATION

- A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrate of projection and substances detrimental to work; comply with recommendations of prime materials manufacturer.
- C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections.
- D. Install separate flashings and corner protection stripping as recommended by prime materials manufacturer, where indicated to proceed application of dampproofing. Comply with details shown and with manufacturer's recommendations. Pay particular attention to requirement at building expansion joints, if any.
- E. Verify items which penetrate surfaces to receive dampproofing are securely installed.
- F. Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

3.03 APPLICATION

- A. Apply fluid-applied dampproofing by spray, brush, or roller in accordance with manufacturer's instructions.
- B. Exterior Concrete block/masonry surfaces:
 - 1. Apply dampproofing at a minimum rate of 3 gal/100 ft² (1.2 L/m²) unless otherwise recommended by manufacturer as required to achieve a continuous, uniform film.
 - 2. Apply by spray, brush, or roller to produce continuous, uniform film without pinholes or voids.
 - 3. Apply in multiple passes if needed to achieve required coverage without pinholes, voids, or runs.
 - 4. Allow dampproofing to fully cure prior to placement of insulation boards (no transfer when touched).
- C. Inspect dampproofing film for continuity and repair pinholes or voids with additional material prior to insulation placement.
- D. Correct deficiencies before covering.

3.04 INSULATION OF XPS INSTALLATION

- A. Place extruded polystyrene (XPS) boards directly against cured dampproofing per requirements of Section 07 21 00.

3.05 PROTECTION

- A. Protect dampproofed surfaces from damage during backfill operations.
- B. Backfill with free-draining material; do not drop fill directly against insulation boards.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes building thermal insulation and accessories, including but not limited to the following:
 - 1. Rigid board thermal insulation on exterior walls.
 - 2. Rigid insulation at perimeter foundation walls
 - 3. Batt insulation in ceiling construction.
- B. Related Sections:
 - 1. Section 04 22 00 – Concrete Unit Masonry
 - 2. Division 23, Mechanical: Insulation for ducts, heating, air conditioning, ventilating, and plumbing work shall be furnished and installed by the respective Mechanical Contractor.

1.02 ACTION SUBMITTALS

- A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.
 - 1. Product Data: Manufacturer's product data sheets, specifications, performance data, physical properties for each item furnished hereunder.

1.03 QUALITY ASSURANCE

- A. Single Source Responsibility: Furnish each insulation type from one manufacturer for entire Project, unless otherwise acceptable to Architect.
- B. Insulation Thermal Properties: Thermal resistance R-values indicated are values at 75 degree mean temperature. Where insulation is identified by R-value, provide thickness required to achieve indicated R-value. Foam plastic insulation R-values are "aged" thermal values in accordance with RIC/TIMA conditioning procedure.
- C. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products in accordance with test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
- D. Foam plastic insulation: Foam plastic insulation cores, coatings and facings shall meet the following classification requirements when tested in accordance with ASTM E84.
 - 1. Exterior walls: Flame spread rating of 25 or less; smoke developed rating of 450 or less.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Insulation shall be legibly marked with the following data:
 - 1. Its "R" value per inch and the mean test temperature
 - 2. The manufacturer's name
 - 3. The insulation type and its tradename
 - 4. Water vapor transmission (perm inch average)
 - 5. UL rating – flame spread, fuel contribution, smoke developed (ASTM E84 and D1692)
- B. Deliver insulation materials in manufacturer's original, unopened, and labeled packages.
- C. Provide adequate protection for all materials stored on site and after installation. Protect insulation from physical damage, and from becoming wet and soiled.
- D. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.05 ENVIRONMENTAL CONDITIONS

- A. Do not install insulation during inclement weather or when surfaces are moist.
- B. Insulation that is exposed to moisture due to inadequate or compromised environmental protections, or that becomes wet or moist by other means subsequent to installation, shall be completely removed and discarded, and replaced with new materials.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Rigid insulation board (extruded polystyrene):
 - a. DuPont de Nemours, Midland, MI.
 - b. Owens-Corning Co., Parsippany, NJ.
 - c. Kingspan Insulation NA, Atlanta, GA
 2. Glass Fiber Batt Insulation:
 - a. CertainTeed Corp., Valley Forge, PA
 - b. Owens-Corning, Toledo, OH
 - c. Knauf Insulation, Shelbyville, IN
 - d. Johns Manville, Denver, CO

2.02 INSULATION MATERIALS

- A. Provide insulating materials that comply with requirements and with referenced standards; sized to fit applications indicated, selected from manufacturer's standard thickness, widths, and lengths.

2.03 GLASS-FIBER BLANKET INSULATION

- A. Fiberglass Batt/Blanket Insulation: Glass or other inorganic fibers and resinous binders formed into flexible batts or blankets.
 1. Unfaced Glass Fiber Insulation (typically in ceilings as indicated on drawings):
 - a. ASTM C665, Type I, preformed formaldehyde free glass fiber batt type, passing ASTM E136 for combustion characteristics.
 2. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:
 - a. 3-1/2 inches thick with a thermal resistance (R-value) of 11.
 - b. 5-1/2 inches thick with a thermal resistance (R-value) of 19.
 - c. 12 inches thick with a thermal resistance (R-value) of 38
 3. Fire Rating: ASTM E84, Flame spread 25 or less and smoke development 50 or less.
 4. Non-combustible: classified non-combustible per ASTM E136 at 750°C
 5. Acceptable Manufacturers:
 - a. Commercial Blanket Insulation, CertainTeed Corp.
 - b. Unfaced Commercial Insulation, Johns Manville.
 - c. PINK NextGen Fiberglas Insulation, Owens Corning.

2.04 FOAM-PLASTIC BOARD INSULATION

- A. Cavity Wall Insulation (Rigid Insulation): Rigid closed-cell, extruded polystyrene thermal board insulation formed from polystyrene base resin by an extrusion process using hydrochlorofluorocarbons as blowing agent to comply with ASTM C578 for type and with other requirements indicated below: Polyisocyanurate board not permitted.
1. Thermal Resistivity: Not less than 5.6 per inch $\text{ft}^2 \times \text{h} \times ^\circ\text{F}/\text{Btu} \times \text{in.}$ 75 deg F mean temp.
 2. Thickness or Thermal Resistance (R-Values): As scheduled; value determined at not less than 6 months after manufacture.
 - a. Where insulation is indicated by the following thicknesses, provide boards with thermal resistances indicated:
 - 1) 2 inches thick with a thermal resistance (R-value) minimum of 10.0.
 3. Classification: ASTM C578, Type IV, density of 1.45 lb/cu ft. minimum density.
 4. Fire Rating: ASTM E84, 1 inch thick test material, flame spread 25 or less, smoke development 450 or less.
 5. Acceptable Manufacturers:
 - a. Basis of Design: DuPont Styrofoam Brand Cavitymate
 - b. Kingspan GreenGuard
 - c. Owens Corning Foamular.
- B. Foundation Perimeter Board Insulation: Rigid closed-cell, extruded polystyrene thermal board insulation formed from polystyrene base resin by an extrusion process using hydrochlorofluorocarbons as blowing agent to comply with ASTM C578 for type and with other requirements indicated below:
1. Thermal Resistivity: Not less than 5 per inch $\text{ft}^2 \times \text{h} \times ^\circ\text{F}/\text{Btu} \times \text{in.}$ 75 deg F mean temp.
 2. Thickness or Thermal Resistance (R-Values): As scheduled; value determined at not less than 6 months after manufacture.
 - a. Where insulation is indicated by the following thicknesses, provide boards with thermal resistances indicated:
 - 1) 2 inches thick with a thermal resistance (R-value) of 10.
 - 2) 3 inches thick with a thermal resistance (R-value) of 15.
 3. Classification: ASTM C578, Type IV, density of 1.45 lb/cu ft. minimum density.
 4. Fire Rating: Surface-burning characteristics: Maximum flame spread and smoke-developed indices of 15 and 175, respectively.
 5. Acceptable Manufacturers:
 - a. Basis of Design: DuPont Styrofoam Brand Scoreboard
 - b. Kingspan GreenGuard.
 - c. Owens Corning Foamular.

2.05 AUXILIARY INSULATING MATERIALS

- A. Rigid Board Adhesives: Provide insulation manufacturer's recommended adhesives for sealing joints and bonding insulation to substrates shown. Adhesives shall be compatible with insulation materials secured.
- B. Supplementary Support: Galvanized steel hexagonal wire mesh where required for supplementary support of insulation in permanent proper location. Provide manufacturer's recommended fasteners.
- C. Tape: Self-adhering pressure sensitive, compatible with insulation, foil type recommended by manufacturer of insulation.
- D. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.

- E. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
 - 1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.
- F. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare surfaces and areas to receive insulation material as required by the manufacturer. Do not install materials in unsatisfactory areas or to improperly prepared surfaces.
- B. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.
- C. Verify substrate and conditions under which insulation work is to be performed. Do not proceed with installation until unsatisfactory conditions have been corrected.
- D. Verify substrate surface is clean, flat, dry, free of irregularities, and ready to receive insulation materials.
- E. Verify insulation boards are dry, unbroken, and free of damage.

3.03 INSTALLATION – GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.04 INSTALLATION – RIGID BOARD INSULATION

- A. Foundation Insulation: Install board insulation on foundation perimeter with adhesive in accordance with manufacturer's instructions.
 - 1. Installation: Install XPS insulation only after dampproofing is fully cured, with no transfer of coating when touched.
 - a. Place boards directly against cured dampproofing in a vertical orientation, tight to foundation wall.
 - b. Stagger vertical joints and install boards in running bond pattern.
 - c. Butt edges tightly; gaps greater than 1/4 inch shall be filled with insulation cut to size.
 - d. Do not use adhesives containing solvents.
 - e. Boards may be temporarily held in place with compatible mechanical fasteners, spot-adhesive dabs of dampproofing, or manufacturer-approved methods until backfill stabilizes placement.
 - f. Extend insulation continuously from top of footing to finish grade unless otherwise noted.

- B. Wall Insulation: Install board insulation horizontally beginning at bottom of cavity.
 - 1. Secure insulation with adhesive.
 - 2. Stagger joints between courses.
 - 3. Place boards in method to maximize contact bedding.
 - 4. Butt edges and ends tight to adjacent board and to protrusions.
 - 5. Cut and shape insulation with knife, handsaw, or other cutting tool as required to fit around penetrations, projections, and openings to accommodate conduit or other services.
 - 6. Seal cut-outs with manufacturer's recommended sealant.
- C. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
 - 1. Bond with adhesive to vertical substrate. Stagger all joints. Butt edges and ends tight to adjacent board with no protrusions.
 - 2. Protect insulation from displacement and damage during backfilling and slab placement.
- D. Install boards on exterior walls vertically and hold in place with Z-furring channels spaced at maximum 24 inches on center.
 - 1. Install panels and furring channels progressively starting at corner condition. Space furring channels not more than 12 inches from corner at interior corners and not more than 3 inches from corner at exterior corners.
 - 2. Install insulation full height of wall. Stagger horizontal joints. Cut insulation to fit non-standard spaces. Bond with adhesive to vertical substrate.

3.05 INSTALLATION – BATT AND BLANKET INSULATION

- A. Provide batt insulation where indicated and where the insulation is not part of another Specification Section. Install insulation after plumbing, mechanical, and electrical services have been installed.
- B. Install fiberglass blankets/batts in cavities formed by framing members according to the following requirements:
 - 1. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends. Use batts free of damage and stagger butt joints.
 - 2. Place blankets/batts in cavities formed by members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Provide mechanical fasteners, wire mesh, or other accessories to ensure insulation remains in specified position.
 - 4. Fit insulation tight within spaces and tight to exterior side of plumbing, mechanical, and electric services within plane of insulation leaving no gaps or voids.
 - 5. Cut and fit tightly around all obstructions and fill all voids around all cutouts for lights, cabinets, pipes and plumbing, HVAC ducts, electrical boxes, and other irregularities. Provide 3 inch clearance around non-IC recessed light fixtures unless lighting fixtures are rated for contact with insulation.
 - 6. Install insulation within metal framing systems full height and width. Do not allow voids or openings to occur. Insulation is required for full width between studs, including cavity of each stud.
 - 7. Cut insulation oversize to ensure tight butt joints when installed. Cut insulation to fit around protrusions and irregularly shaped projections.
 - 8. For metal-framed wall cavities where cavity heights exceed 96 inches, and the insulation does not completely fill the cavity, support unfaced blankets mechanically and support faced blankets either mechanically or by taping flanges of insulation to flanges of metal studs.
- C. Stuff glass fiber loose fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume (to a density of approximately 2.5 pcf).

3.06 PROTECTION

- A. Protect installed insulation and vapor retarders from harmful weather exposures and from possible physical abuses, where possible non-delayed installation of concealing work, or where that is not possible, by temporary covering or enclosure.

- B. Seal all cuts, punctures and penetration of integral insulation vapor barriers with vapor barrier tape before installing surface finishes.

END OF SECTION

SECTION 07 26 16
BELOW GRADE VAPOR RETARDERS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section included providing sheet membrane vapor retarders under concrete slabs-on-grade including all accessory item.
- B. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete
 - 2. Section 31 00 00 – Earthwork

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
 - 2. ASTM E1643: Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- B. Technical Reference - American Concrete Institute (ACI):
 - 1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
 - 2. ACI 302.1R-15 Guide to Concrete Floor and Slab Construction.

1.03 ACTION SUBMITTALS

- A. Prepare the following submittals in accordance with Section 01 30 00 – Submittal Procedures.
- B. Information and Review Submittals:
 - 1. Product Data: Manufacturer's product data sheets, specifications, performance data, physical properties for each item furnished hereunder.
 - 2. Manufacturer's Instructions: Manufacturer's installation instructions for placement, seaming and pipe boot installation.
- C. Quality control/assurance submittals:
 - 1. Summary of test results per paragraph 9.3 of ASTM E1745.
 - 2. Manufacturer's samples and literature.
 - 3. Manufacturer's installation instructions for placement, seaming, penetration prevention and repair, and perimeter seal per ASTM E1643.
 - 4. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Take precautions to prevent puncturing, tearing and damage to vapor retarder.

1.05 COORDINATION

- A. Section 31 00 00 for compacted subgrade under vapor retarder, fully compacted and complete.
- B. Section 03 30 00 – Cast-in-Place Concrete
- C. Division 22 and Division 26 for penetrations through vapor retarder.
 - 1. Penetrations through the vapor retarder shall be coordinated and sequenced to allow proper flashing and sealing of all penetrations prior to placement of concrete.
 - 2. Penetrations through the vapor retarder shall be flashed and sealed prior to placement of concrete.
 - 3. Utility penetrations through the vapor retarder shall be a minimum of 12-inches apart.

PART 2 – PRODUCTS

2.01 UNDER SLAB VAPOR RETARDERS

- A. Basis of Design manufacturer and product:
 - 1. Specified Product (Basis of Design): To establish a standard of quality, design and function desired, Drawings and specifications have been based on Stego Industries LLC company, San Clemente, CA.
 - 2. Product: "Stego Wrap Vapor Barrier (15 mil)".
- B. Acceptable manufacturers and products:
 - 1. W.R. Meadows, Hampshire, IL.
 - a. Product: "No. 723 Perminator (15 mil)".
 - 2. Reef Industries, Houston, TX,
 - a. Product "Griffolyn -15 Mil Green".
 - 3. Raven Industries, Souix Falls, SD
 - a. Product: Vapor Block 15, (15-mil) polyolefin vapor retarder
- C. Performance requirements:
 - 1. Maintain permeance of less than 0.01 Perms [grains/(ft² /hr/inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
 - 2. Minimum thickness: 15 mils.
 - 3. Water Vapor Permeance ASTM F1249 – Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor: 0.0086 perms.
 - 4. Tensile Strength ASTM D882 – Test Method for Tensile Properties of Thin Plastic Sheeting: 70.6 lbf/in
 - 5. Puncture Resistance ASTM D1709 – Test Method for Impact Resistance of Plastic Film by Free-Falling Dart Method: 2,266 grams

2.02 ACCESSORIES

- A. General: Tapes, adhesives and fasteners required for the proper and complete installation for work of this Section shall be as recommended by each respective manufacturers of each type of vapor barrier.
- B. Pressure Sensitive Tape, Seam Splice Tape Primer, Boots, and Other Accessories: As instructed by manufacturer for watertight impermeable underslab retarder.
- C. Perimeter edge seal: Termination bar or recommended sealing tack tape by vapor retarder manufacturer.
- D. Vapor barrier safe concrete accessories by vapor retarder manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify installation conditions as satisfactory to receive work of this Section.
 - 1. Underslab Utilities: Drain lines and utilities properly installed and ready for work of this Section.
 - 2. Through-Slab Penetrations: Ready for work of this Section.
- B. Verify subgrade is compacted, smooth, level and free from conditions that may cause puncture or other damage to vapor retarder.

3.02 PREPARATION

- A. At slabs on grade, rake and level irregular subgrades within a tolerance of 1/2 inch and then re- recompact.

3.03 INSTALLATION – BELOW-SLAB VAPOR RETARDERS

- A. General: Install Vapor Barrier in accordance with manufacturer's instructions and ASTM E 1643. Place vapor barrier beneath all floor slabs. Install vapor retarder sheet over compacted capillary break material.
- B. Unroll Vapor Barrier with the longest dimension parallel with the direction of the pour and with minimum number of joints.
- C. Lap vapor retarder over footings, turn up to full slab thickness, and seal with pressure sensitive tape to foundation walls.
- D. Overlap joints a minimum of six inches with top lap in direction of spreading concrete. Turn up double layer at slab edges abutting walls. Seal with manufacturer's tape.
- E. Seal pipe penetrations (including pipes, reinforcing steel, and permanent utilities) with vapor retarder or prefabricated boots and pressure sensitive tape. Field fabricate boots and other shapes as necessary to seal vapor retarder against vapor penetration.
- F. Do not puncture vapor barrier. No punctures or unsealed penetrations are permitted.
- G. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.
- H. Place concrete slab-on-grade directly over installed vapor retarder under work of Section 03 30 00. Do not install granular fill layer over vapor retarder.

3.04 FIELD QUALITY CONTROL

- A. Inspect completed installation prior to placing concrete slab-on-grade.
- B. Verify vapor retarder installed in accordance with manufacturer's instructions with penetrations taped and sealed.
- C. Verify that vapor retarder has not been penetrated by screed stakes and that base set screed posts are in place.

3.05 ADJUSTMENTS

- A. Patch penetrations with pressure sensitive tape and make adjustments as necessary to maintain performance of vapor retarder as instructed by manufacturer.
- B. Repair damaged areas by cutting vapor retarder patches. Overlap tears and holes 6 inch beyond damaged area with patches. Seal patch to installed vapor retarder with pressure sensitive tape or as instructed by manufacturer.
- C. Promptly patch tears and punctures as they occur. Do not patch or seam when vapor retarder is wet.

3.06 PROTECTION

- A. Protect From Penetration: Do not permit use of ground set stakes, screed posts, and other items to puncture vapor retarder. Where punctured, remove penetrating item and patch vapor retarder, as specified this Section, before placing concrete.
- B. Lay plywood or other protection board over installed vapor retarder at areas of heavy traffic and other construction loads. Do not stack construction materials directly on vapor retarder.

END OF SECTION

SECTION 07 27 26
FLUID-APPLIED MEMBRANE AIR BARRIER

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes a vapor-permeable system of fluid applied coatings to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls. Section includes:
 - 1. Substrate preparation over painted concrete masonry units (CMU).
 - 2. Joint and seam treatment
 - 3. Transition membrane materials
 - 4. Flashing at rough openings and penetrations
 - 5. Accessories and sealants

1.02 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air and acts as a waterproof weather-resistive barrier.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.03 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E2357.

1.04 ACTION SUBMITTALS

- A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.
- B. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.
- C. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 1. Include details of interfaces with other materials that form part of air barrier.
 - 2. Include details of mockups.

1.05 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.
- C. Qualification Data: For Applicator.

1.06 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance and that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. Qualifications: Minimum 3 years' experience with fluid-applied air barriers and approved by manufacturer.
- B. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly, 100 sq. ft., 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, and sealing of gaps, terminations, and penetrations of air barrier membrane.
 - 1. Coordinate construction of mockup to permit inspection of air barrier before external insulation and cladding is installed.
 - 2. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
 - 1. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Include installers of other construction connecting to air barrier, including roofing, waterproofing, architectural precast concrete, masonry, sealants, windows, glazed curtain walls, and door frames.
 - 2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Store rolls according to manufacturer's written instructions.
- D. Protect stored materials from direct sunlight.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.09 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to replace air barrier material that does not comply with requirements or fails to for specified barrier within specified warranty period.
 - 1. Warranty does not include failure of air barrier membrane due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch in width.
 - 2. Warranty Period: Five years from the date of Substantial Completion.
- B. Special Installer's Warranty: Standard form, signed by Installer, covering Work of this Section for a warranty period of two years.
 - 1. Warranty includes removing and reinstalling cladding, finish panels, and overburden on surfaces the air barrier is installed upon.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Prosoco; R-Guard Cat 5 or R-Guard MVP
- B. Acceptable Manufacturers/Products: Subject to compliance with requirements, provide basis of design or comparable products of one of the following.
 - 1. Carlisle Coatings & Waterproofing Inc.; Barritech VP.
 - 2. DuPont; Tyvek Fluid Applied WB+ System.
 - 3. GE/Momentive Performance Materials; SEC2500 SilShield AWB.
 - 4. GCP Applied Technologies, Inc., Perm-A-Barrier VPL.
 - 5. Henry Company; Air-Bloc 31/ Air-Bloc 33
 - 6. Sto Corp; Sto AirSeal.
 - 7. Tremco Incorporated, an RPM company; ExoAir 230.

2.02 FLUID-APPLIED MEMBRANE AIR BARRIER

- A. Source Limitations: Supply primary air-barrier materials and air-barrier accessories from single manufacturer.
- B. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric synthetic polymer membrane.
 - 1. Basis of Design: PROSOCO R-GUARD CAT 5 fluid-applied air and water-resistive barrier.
 - 2. Type: Single-component, silyl-terminated polymer (STP) based, vapor-permeable.
 - 3. Physical and Performance Properties:
 - a. Air Permeance: Less than 0.0006 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
 - b. Water Vapor Transmission: > 23 perms (ASTM E96, Method B)
 - c. Ultimate Elongation: Minimum >300 percent; ASTM D 412, Die C.
 - d. Service Temperature: -40°F to 200°F
- C. Liquid-applied flashing for all window, door, MEP penetrations, inside/outside and dissimilar material connections shall be Prosoco R-Guard FastFlash; a moisture-curing single component STPe liquid-applied flashing compatible with a variety of substrates and all fluid-applied R-Guard air barrier membranes. Liquid-flashing shall have the following physical properties:
 - 1. Elongation: minimum 350% minimum to ASTM D412.
 - 2. Tensile Strength: >150 psi tested in accordance with ASTM D412.
 - 3. VOC Content: 25 g/L max.
 - 4. Solids Content by Volume: 99%.

2.03 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid primer recommended for substrate by manufacturer of air barrier material.
- C. Counterflashing Strip: Modified bituminous, 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 32 mils (0.8 mm) of rubberized asphalt laminated to an 8-mil- (0.2-mm-) thick, crosslaminated polyethylene film with release liner backing.
- D. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, 0.0250 inch thick, and Series 300 stainless-steel fasteners.
- E. Butyl Strip: Vapor-retarding, 30- to 40-mil- (0.76- to 1.0-mm-) thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.
- F. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.
- G. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- H. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

- I. Adhesive-Coated Transition Strip: Vapor-permeable, 17-mil- (0.43-mm-) thick, self- adhering strip consisting of an adhesive coating over a permeable laminate with a permeance of 37 perms (2145 ng/Pa x s x sq. m).
 - 1. Product: R-GUARD Transition Membrane.
- J. Through-wall Flashing Membrane: SBS modified bitumen, self-adhering type, integrally laminated to a glass scrim reinforced aluminum foil film.
 - 1. Product: R-GUARD FastFlash.
- K. Joint Sealant:
 - 1. High performance, gun-grade waterproofing sealant that combines the best of silicone and polyurethane properties. Single component, Silyl-Terminated-Polymer (STP) that is durable and stops the movement of moist air through cracks surrounding windows and doors
 - a. Product: PROSOCO R-Guard AirDam, manufactured by PROSOCO, Inc.
 - 2. Subject to compliance with the following physical and performance requirements:
 - a. Comply with national, state and district AIM VOC: less than 30 grams per Liter
 - b. Sealant Validation from Sealant Waterproofing & Restoration Institute (SWRI).
 - c. Elongation at break: Greater than 1000 percent when tested in accordance with ASTM D412.
 - d. Peel strength: 25 pli when tested in accordance with ASTM C794
 - e. Total solids: 98 percent.
 - 3. Backer rod: In deep joints, control sealant depth by installing closed cell backer rod. Diameter of the soft-backer rod should be 25 percent greater than the joint width. Do not puncture backer rod.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
 - 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
 - 4. Verify that masonry joints are flush and completely filled with mortar.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate per manufacturer instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjacent and adjoining surfaces including storefront and glazing and other prefinished materials that are to remain in the completed work.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Ensure painted CMU is well-adhered to substrate—peeling/flaking paint must be removed. Abrade or scarify painted surface if necessary to enhance bonding.
- F. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- G. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

- H. Concrete and Masonry: Prepare, treat, rout, and fill open joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer recommendations. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
- I. Sheathing:
 - 1. Joints and gaps to 1/4 inch width may be filled with sealant if acceptable to air barrier manufacturer.
 - 2. Seal cut edges that receive air barrier per membrane manufacturer's recommendations.
- J. Cover gaps in substrate plane and form smooth transitions from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier membrane.
 - 1. Contractor Option: Self-adhesive stainless steel flashing.
- K. Bridge isolation joints, deflection joints, expansion joints, and discontinuous wall-to-wall, deck- to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer recommendations and details.

3.03 ACCESSORIES INSTALLATION

- A. Install accessory materials according to air-barrier manufacturer recommendations and details to form air- and water-tight seals with adjacent construction for continuity of air and water barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install transition strip on roofing membrane or base flashing so that minimum 3 inches of coverage is achieved over each substrate.
 - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
 - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal air-barrier membrane continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that minimum 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
 - 1. Transition Strip: Roll firmly to ensure adhesion.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with closed-cell foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.04 AIR BARRIER MEMBRANE INSTALLATION

- A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions and details.
- B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.
- C. Apply primer to substrates, where recommended by manufacturer, at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
 - 2. Apply primer to all areas to receive transition sheet and / or through-wall flashing membrane, as indicated on drawings by roller or spray and allow minimum 30 minute open time.
- D. Transition Sheet:
 - 1. Position self-adhered transition membrane and remove protective film. Press firmly into place. Ensure minimum 2" overlap at all end and side laps.
 - 2. Promptly roll all laps with a counter top roller to effect seal.
 - 3. Ensure all preparatory work is complete prior to installing Air-Bloc 33.
- E. Through-wall Flashing Membrane (Self-Adhering Type)
 - 1. Align and position the leading edge of self-adhering through-wall flashing membrane with the front horizontal edge of the foundation walls or self angles, partially remove protective film and roll membrane over surface and up vertically.
 - 2. Press firmly into place. Ensure minimum 2" overlap at all end and side laps.
 - 3. Promptly roll all laps and membrane to effect the seal.
 - 4. Ensure through-wall flashing membrane extends fully to the exterior face of the exterior masonry veneer. Trim off excess as directed by the consultant.
 - 5. Apply through-wall flashing membrane along the base of masonry veneer walls, over windows, doors and all other wall openings. Membrane shall form continuous flashing and shall extend up a minimum of 8-inches up the back-up wall.
- F. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions.
 - 1. Vapor-Permeable Membrane Air Barrier: 120-mil (3.0-mm) wet film thickness.
- G. Apply strip and transition strip a minimum of 1 inch (25 mm) onto cured air membrane or strip and transition strip over cured air membrane overlapping 3 inches (75 mm) onto each surface according to air barrier manufacturer's written instructions.
- H. Do not cover air barrier until it has been tested and inspected by Owner's testing agency substrates and reapply air barrier components.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 - 1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Continuous structural support of air barrier system has been provided.
 - 3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
 - 4. Perform field adhesion test prior to start of work.
 - 5. Site conditions for application temperature and dryness of substrates have been maintained.
 - 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 7. Surfaces have been primed, if applicable.

8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 9. Termination mastic has been applied on cut edges.
 10. Strips and transition strips have been firmly adhered to substrate.
 11. Compatible materials have been used.
 12. Transitions at changes in direction and structural support at gaps have been provided.
 13. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
 14. All penetrations have been sealed.
- C. Tests: As determined by testing agency from among the following tests:
1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
 2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E 783.
 3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.
- D. Air barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional air-barrier material, according to manufacturer recommendations, where inspection results indicate insufficient thickness.
 2. Remove and replace deficient air-barrier components for retesting as specified above.
- E. Repair damage to air barriers caused by testing; follow manufacturer recommendations.
- F. Prepare test and inspection reports.

3.06 CLEANING AND PROTECTION

- A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 30 days.
 2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION

SECTION 07 31 36
SYNTHETIC SHAKE SHINGLES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Synthetic shake Shingles, underlayment, flashing, fasteners, snow guards and accessories.
- B. Related Requirements:
 - 1. Section 07 62 00 - Sheet Metal Flashing and Trim.
 - 2. Section 07 92 00 - Joint Sealers

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM) (www.astm.org):
 - 1. D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
 - 2. D3161/D3161M - Standard Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method).
 - 3. D3462/D3462M - Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules.
 - 4. E108 - Standard Test Methods for Fire Tests of Roof Coverings.
 - 5. G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. Underwriters Laboratories (UL) (www.ul.com):
 - 1. 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings.
 - 2. 2218 - Standard for Impact Resistance of Prepared Roof Covering Materials.

1.03 PRE-INSTALLATION CONFERENCE

- A. Convene at Project site two weeks prior to beginning work of this Section.
- B. Attendance: Architect, Contractor, installer, and related trades.
- C. Review and discuss:
 - 1. Installation procedures and manufacturer's recommendations.
 - 2. Safety procedures.
 - 3. Coordination with installation of other work.
 - 4. Availability of materials.
 - 5. Preparation and approval of substrate and penetrations through roof.
 - 6. Other items related to successful execution of work.

1.04 ACTION SUBMITTALS

- A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings: Show shingle layout, method of attachment, flashings, trim, conditions at eaves, intersections with adjacent materials, and other installation details.
- C. Product Data: Manufacturer's data sheets on each product including:
 - 1. Shingles, underlayment, flashings, snow guards, fasteners, and accessories:
 - 2. Indicate composition, properties, and dimensions.
 - 3. Show compliance with specified requirements.
 - 4. Preparation instructions and recommendations.
 - 5. Storage and handling requirements and recommendations.
 - 6. Installation methods.

D. Samples:

1. Selection Samples: Two sets of color chips representing manufacturer's full range of available colors and surface textures.
2. Verification Samples: After selection, submit two samples representing actual product, color, and texture.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of synthetic shingles.
- B. Installer Qualifications: Minimum three years' experience in work of this Section.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Ship shingles in bundles:
 1. Collate in sequence of widths and colors as required for selected color blend.
 2. Assemble bundles so that sorting at job site is not required.
- B. Deliver shingles to site in manufacturer's unopened, labeled bundles.
 1. Verify quantities and condition upon delivery.
 2. Remove damaged products from site.
- C. Store products in protected environment, off ground, protected moisture, traffic, and construction activities.
- D. Store shingles flat. Do not store on site for prolonged period.
- E. Store products at temperature between 40 and 120 degrees F (4 degrees C and 49 degrees C).

1.07 FIELD CONDITIONS

- A. Observe manufacturer's temperature, humidity, and moisture limits.
- B. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 WARRANTIES

- A. Furnish manufacturer's 50 years warranty against breakage and deterioration resulting in leaks under normal weather and use conditions.
- B. Furnish installer's 2 years total roof system warranty against water penetration, including underlayment, flashings, trim, and other roof components.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: DaVinci Roofscapes, LLC, 800-DAVINCI, www.davinciroofscapes.com.
- B. Snow Guards:
 1. Rocky Mountain Snow Guards, Inc. – Model Rocky Guard RG10.

2.02 MATERIALS

- A. Performance Requirements:
 1. Roof system: Manufactured synthetic shingles attached to structural substrate to form weather tight roof envelope with no measurable water penetration.
 2. Method of attachments designed to adequately resist wind uplift for roof configuration and Project location.
 3. Meet minimum uplift resistance of [93] [186] PSF with 2:1 safety factor in accordance with TAS 125.
- B. Synthetic Shake Shingles:

1. Description: Lightweight, synthetic shake shingles with appearance, color, texture, and thickness of natural wood shakes.
2. Product: Single-Width Shake.
3. Material: Engineered polymer formulated from 100 percent virgin plastic resins; recycled materials not acceptable.
4. Performance characteristics:
 - a. Fire resistance rating: Class A, tested to ASTM E108.
 - b. Impact resistance rating: Class 4, tested to UL 2218.
 - c. Wind resistance rating: 110 MPH, tested to ASTM D3161/D3161M.
5. Size:
 - a. Width: 9 inches (229 mm).
 - b. Length: 22 inches (559 mm).
 - c. Thickness: 5/8 inch (16 mm) at butt, 1/4 inch (6 mm) at top.
6. Starter shingle: 12 inches (305 mm) long x 12 inches (305 mm) wide.
7. Markings: Form shingles with markings on upper surface to indicate nailing locations and provide alignment guidelines for different exposure lengths.
8. Color:
 - a. Multiple colors comparable to natural wood shakes.
 - b. Provide internal UV stabilizers.
9. Shingle pattern:
 - a. Provide shingles factory blended in multiple colors and widths:
 - b. Blend: [Autumn - Variblend.] [Chesapeake - Variblend.] [Mountain - Variblend.] [Tahoe - Variblend.] [Weathered Gray - Variblend.] [Black Oak.] [Aged Cedar.] [Mossy Cedar.] [Custom.]

2.03 ACCESSORIES

- A. Waterproof Sheet Membrane: Cold applied, self-adhering waterproof membrane composed of polyethylene film coated one side with rubberized asphalt adhesive.
 1. Thickness: 40 mils (1 mm).
 2. Low temperature flexibility: Unaffected at minus 32 degrees F (minus 36 degrees C).
 3. Minimum tensile strength: 250 PSI (1724 kPa).
 4. Minimum elongation: 250 percent.
 5. Permeance: Maximum 0.05 perms.
- B. Flashing:
 1. Fabricate from sheet to profiles and dimensions indicated on Drawings and approved Shop Drawings, in accordance with Section 07 62 00.
 2. Material: 26 gage (0.455 mm) galvanized steel.
 3. Linear components: Form in longest possible lengths, 8 feet (2.5 m) minimum.
 4. Counterflashings: Extend minimum 4 inches (102 mm) up vertical surfaces and minimum 4 inches (102 mm) under shingles.
 5. Valley flashings: Minimum 24 inches (610 mm) wide, extending minimum 10 inches (254 mm) from valley center line.
 6. Eave flashings: Fabricate with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.
- C. Fasteners:
 1. 3/8 inch (9.5 mm) flat head nails, 1-1/2 inches (38 mm) long.
 2. Material: Stainless steel
- D. Snow Guards:
 1. Manufacturer: Rocky Mountain Snow Guards, Inc.
 - a. Model: Rocky Guard RG10
 2. Material: Steel, powder-coated finish, color as selected by Architect.

3. Application: Designed for use on synthetic slate roofing systems.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Inspect roof framing and substrate.
 1. Verify that roof is complete, rigid, and braced, and that deck members are securely fastened.
 2. Ensure that proper ventilation has been provided for roof space.
 3. Verify that roof deck is clean, dry, and ready to receive shingles.
 4. Remove dirt, loose fasteners, and protrusions from roof surface.

3.02 INSTALLATION - GENERAL

- A. Install self-adhered waterproof sheet membrane on eaves. Cover waterproof sheet membrane and remaining portions of roof with approved underlayment. Install waterproof sheet membrane in valleys, along walls, and around projections terminating on top of underlayment.
- B. Underlayment:
 1. Install waterproof sheet membrane over full roof area.
 - a. Apply waterproof sheet membrane at temperatures of 40 degrees F (4 degrees C) or higher.
 - b. Adhere and attach as recommended by manufacturer of waterproof sheet membrane.
 - c. Start underlayment installation at lower edge of roof. Install perpendicular to roof slope with minimum 4 inch (102 mm) side laps and minimum 6 inch (152 mm) end laps.
 - d. Extend underlayment minimum 4 inches (102 mm) up vertical wall intersections.
 - e. Do not leave underlayment membrane exposed in excess of time limit required by manufacturer. Do not puncture or tear underlayment.

3.03 FLASHING INSTALLATION

- A. Install drip edge on eaves, gable ends, and metal flashings at valleys, ridges, hips, roof curbs, penetrations, and intersections with vertical surfaces, in accordance with Section 07 62 00.
- B. Weather lap joints minimum 2 inches (52 mm) and seal with sealant as specified in Section 07 92 00.
- C. Secure in place with clips, nails, or other fasteners.

3.04 SHINGLE INSTALLATION

- A. Install shingles in accordance with manufacturer's instructions and approved Shop Drawings.
- B. Accurately lay out shingles. Ensure that edges are parallel and perpendicular to roof eaves. Lay out work to avoid cutting shingles.
 1. At gables and vertical intersections, vary combination of shingle widths and spacing of shingles.
 2. If cutting is required, place shingle so that cut edge is not exposed.
 3. Use circular saw or straight edge and utility knife if cuts are necessary.
- C. Install shingles in rack or pyramid style from factory assembled bundles.
- D. Exposure: Install shingles in straight pattern with 10 inches exposure as indicated, and bottom shingle edges evenly aligned.
- E. Spacing: Provide 3/16 to 3/8 inch (4.76 to 9.5 mm) gap between shingles.
- F. Stagger shingle joints in one course minimum 1-1/2 inches (38 mm) from joints in course below.
- G. Eaves: Install row of starter shingles at eaves as base layer. Project eave shingles approximately 1 inch (25 mm) and 1/8 inch (3 mm) past overhanging drip edge, or as required to allow water to drain.
- H. Ridges: After field shingle installation is complete, install double row of shingles over 6 inches (152 mm) wide metal flashing.

1. Use 6 inch (152 mm) wide shingles with 10 inch (254 mm) exposure or one-piece, 12 inch wide shingle with 10 inch exposure,
 2. Ridges: Start ridge shingles at leeward end. Face shingle laps away from prevailing wind.
- I. Fastening: Attach each shingle to deck with two nails:
1. Place nails at locations indicated on shingles.
 2. Ensure full penetration but do not overdrive nails.
 3. Do not nail at an angle.
 4. Ensure that nail head is flush with shingle surface.
 5. At valleys do not nail shingles within 5 inches (127 mm) of valley center line.

3.05 SNOW GUARD INSTALLATION

- A. Install in accordance with manufacturers printed instructions.
- B. Secure per manufacturer's installation instructions, using corrosion-resistant fasteners compatible with roof system and snow guard material.
- C. Location: As shown on drawings.
- D. Rows: Install in two (2) rows in locations indicated offset horizontally in staggered pattern.
1. Horizontal spacing: 12 inches on center
 2. Vertical spacing or rows: 16 inches on center
 3. Length of rows: 9 feet.
- E. Coordinate placement with roofing contractor to ensure watertight installation.

3.06 FIELD QUALITY CONTROL

- A. Inspect units as they are installed. Do not install cracked, broken, twisted, curled, or otherwise damaged units.
- B. As work progresses, exercise care not to scratch or mar installed shingles. Replace damaged shingles.
- C. After approximately 200 units have been installed, inspect roof from ground. Verify proper layout and appearance. Repeat inspection every 200 shingles.
- D. Visually inspect completed installation for weathertight condition.

3.07 PROTECTION

- A. Protect installed roofing until completion of Project.
- B. Do not allow traffic on completed roof.

3.08 ADJUSTING

- A. Replace damaged shingles prior to Substantial Completion.

END OF SECTION

SECTION 07 41 13
MANUFACTURED ROOF PANELS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes pre-finished, factory-formed architectural steel standing seam roofing system, associated flashings and accessories for a complete weathertight roofing system. Roofing systems includes:
 - 1. Prefabricated roof panels
 - 2. Flashings and trim
 - 3. Ridge vent
 - 4. Gutters and downspouts
 - 5. Snow guards
- B. Related Sections:
 - 1. Section 07 92 00 – Joint Sealants for field-applied sheet metal roofing sealants.

1.02 REFERENCES

- A. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - 1. SMACNA Architectural Sheet Metal Manual.

1.03 ACTION SUBMITTALS

- A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
 - 2. Product Data for Recycled Content: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
 - 3. Product Test Reports SRI: For roofing materials, documentation indicating that roofing materials comply with Solar Reflectance Index requirement.
 - 4. Product Data for Regional Materials: List of proposed regionally manufactured materials and regionally extracted, harvested, or recovered materials. Identify each regionally manufactured material, its source, and cost.
- C. Shop Drawings:
 - 1. Submit complete shop drawings and erection details, approved by the metal roofing manufacturer. Do not proceed with manufacturer of roofing materials prior to review of shop drawings and field verification of all dimensions. Do not use drawings prepared by the architect (owner) for shop or erection drawings.
 - 2. Submit small-scale layouts of panels on roofs, and large-scale details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, snow guards and special details. Furnish roof plans, elevations, and methods of erection.
 - 3. Submit layouts of panels including details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, ridge vent, closures, and special details. Submit similar details of roof drainage system.
 - 4. Drawings shall include material type, metal thickness, finish, method of fabrication, method of installation method of anchorage to accommodate thermal movement, and sealant data.
 - 5. Include roof plans showing location and attachment details of rail-type snow guards.
 - 6. Include calculation of number and location of snow guards based on snow load, roof slope, roof type, components, spacing, and finish.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.04 INFORMATIONAL SUBMITTALS

- A. Product Certificates: Signed by manufacturers of the following products certifying that the products furnished comply with requirements:
 1. Sheet metal roofing.
 2. Special finishes.
- B. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Sample Warranties: For special warranties.
- D. Maintenance Data: For metal panels to include in maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage a manufacturer certified and experienced installer with not less than five years of successful experience and who has completed sheet metal roofing similar in material, design, forming method, and extent to that indicated for this Project, certified or licensed by the manufacturer, and with a record of successful in-service performance.
 1. Installer shall be trained and certified by the metal roofing system manufacturer with trained supervisory personnel observing and directing work.
 2. Certificate: When requested, submit certificate indicating qualifications.
- B. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, Manufacturer's installation instructions and manufacturer's warranty requirements. Comply with provisions of Section 01 31 00 – Project Coordination.
- C. Industry Standard: Comply with the Sheet Metal and Air Conditioning Contractors National Association's (SMACNA) "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown.
- D. Field Measurements: Prior to fabrication of metal panels, take field measurements of structure or substrates to receive panel system. Verify panel layout with roof plan and notify Architect of any discrepancies.
- E. Manufacturer: Obtain all materials from a single manufacturer. Provide secondary materials as recommended by the manufacturer of primary materials.
 1. A representative of the roofing manufacturer shall inspect the progress of the work at critical stages to determine that conditions for installation is progressing in accordance with the manufacturer's approved procedures.
 2. Critical stages are defined as commencement of installation, midway through installation, and at the completion of the installation.
 3. Provide copy of roofing system manufacturer's inspection reports for each of these stages within seven days of the inspection.

1.06 PREINSTALLATION CONFERENCE

- A. Meet with Architect, sheet metal roofing Installer and installers whose work interfaces with or affects sheet metal roofing including installers of roof accessories and roof-mounted equipment.
- B. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- C. Review methods and procedures related to sheet metal roofing installation.
- D. Examine sheathing conditions for compliance with requirements, including flatness and attachment to structural members.
- E. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal roofing.

- F. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
- G. Review temporary protection requirements for sheet metal roofing during and after roofing installation.
- H. Review roof observation and repair procedures after sheet metal roofing installation.
- I. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.08 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.09 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems 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 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 Delta E units when tested according to ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
- B. Solar Reflectance Index: Not less than 28 when calculated according to ASTM E 1980.
- C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 or ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft.
- E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft.
- F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind- uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- G. 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.

2.02 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
- B. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- C. Basis-of-Design Product: The design for sheet metal roofing is based on products of Dimensional Metals, Columbus, OH.
 - 1. Subject to compliance with requirements, provide the named basis of design product or a comparable product by one of the following:
 - a. Dimensional Metals, Inc., Reynoldsburg, OH, "double lock panel DL15."
 - b. Petersen Aluminum Corp. Acworth, GA "PAC-150 180 degree Double Lock"
 - c. ATAS International Inc., Allentown, PA. "1-1/2 inch Field-Lok."
 - 2. Comparable system manufacturer shall provide a warrantable standing seam roofing system in accordance with the specification requirements. Nothing specified herein shall supersede the basis of design manufacturers system requirements and specifications. Differences in product or materials properties between the named "Basis of Design" and other named manufacturers shall be accommodated and provided.

- D. Basis-of-Design Product Description: The following establishes the minimum level of quality, performance, dimension, and appearance required.
1. Seam Height: 1-1/2 inch seam height.
 2. Panel Width: 17 inches o.c. (Field verify)
 3. Prefinished Material: 24 gauge steel, hot-dipped galvanized; ASTM A446, Grade C G90 coating A525 gauge core steel.
 4. Texture: Smooth.
 5. Length: Full length of roof slope, without lapped horizontal joints.
 6. Rating: UL Classified 90 rated (wind uplift) panel assembly.
 7. Fasteners: Manufacturer's recommended fasteners, compatible with materials being fastened and UL Classified 90 rated.
 8. Sealant Bead: Factory-applied sealant bead.

2.03 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment (**0730 U**): Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
- B. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
1. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dimensional Metals; DynaClad® Ultra HT Wind & Water Seal™
 - b. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - c. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT.
 - d. Henry Company; Blueskin PE200 HT.
 - e. IMETCO; Aqua block.
 - f. Owens Corning; WeatherLock Metal High Temperature Underlayment.
- C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.04 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels 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 metal panels.
- C. Ridge Vent: Provide manufacturers standard continuous ridge vent for ventilation of attic space.
- D. Metal Fascia: Standard metal fascia material by metal roofing manufacturer. Products with comparable materials, panel profiles, performance criteria and colors by manufacturers listed are also acceptable.
1. Wrapped formed fascia.
 2. Drip edges.
 3. Miscellaneous trim and flashings.
 4. Concealed Fasteners: Manufacturer's recommended type, size and length required for installation conditions.
 5. Color: Match roofing color.

- E. Gutters: Formed from same material roof panels. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 10-foot- long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced per SMACNA's recommendation based on gauge and stretch-out, fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match [metal roof panels and roof fascia and rake trim.
 - 1. Gutter Hangers: External gutter supports shall be 2-inch- wide x 1/4- inch- thick formed aluminum, and shall be spaced at no greater than 36" on center. External supports shall be post-painted with a matching full strength 70 percent PVDF finish and warranted by the panel manufacturer for same term as specified for material finishes.
 - 2. Gutter Straps: Internal gutter straps shall be 1-inch- wide x 1/8-inch- thick formed aluminum, and shall be spaced at no greater than 36" (0.9m) on center. Internal straps shall be post-painted with a matching full strength 70 percent PVDF finish and warranted by the panel manufacturer for same term as specified for material finishes.
- F. Downspouts:: Formed from same material as roof panels. Fabricate in 10-foot long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual". Finish downspouts to match gutters.
 - 1. Downspout Brackets: Where detailed, surface mounted downspout protection guards shall be fabricated from 1/4-inch- thick formed aluminum, and shall be post-painted with a matching full-strength 70 percent PVDF finish and warranted by the panel manufacturer for same term as specified for material finishes.
- G. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- H. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.
- I. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels, and complete with predrilled holes, clamps, or hooks for anchoring. Snow guards shall be illustrated with the panel manufacturer's installation drawings, and shall be designed to resist the sliding force of snow in accordance with the requirements of ASCE-7. Confirming calculations shall be provided by the panel manufacturer.
 - 1. Seam-Mounted, Bar-Type Snow Guards: Extruded Aluminum rods or bars held in place by aluminum clamps attached to vertical ribs of standing-seam metal roof panels.
 - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Metal Roof Innovations, Ltd.; S-5! Attachment Solutions.
 - b. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc.; Standing Seam Fence Snow Mak style snow guard.
 - c. LMCurbs: S-5 Colorguard System
 - d. SnowBar beam mounted rail system.
 - e. Snow Management Systems; a division of Contek, Inc.
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide S-5! ColorGard system as manufactured by Metal Roof Innovations, Ltd, or approved equal.
 - a. System to include extrusions, prefinished metal strips matching roof panels, splice connectors for crossmember sections, fasteners, and all related items necessary for a complete installation.
 - b. Crossmember is to be continuous and include splice connectors to join adjacent sections, ensuring alignment and structural continuity. Attach crossmember to clamps using minimum 3/8" diameter stainless steel bolts with flat washers.

- c. Provide S-5-U clamps manufactured by Metal Roof Innovation complete with stainless steel set screws and stainless steel bolt and washer as furnished by the manufacturer to attach the system to the standing seam roof. Clamp spacing as calculated and not exceeding 32" o.c.
- 4. Description: Snow guard rails fabricated from metal, bars, or extrusions, anchored to brackets and equipped with one rail with color-matching inserts of material and finish used for metal roofing.
- 5. Material and Finish: Aluminum; finish to match SSMR color.

2.05 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, 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.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
- E. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the 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. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and 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 recommended in writing by metal panel manufacturer.

2.06 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. 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 same piece are unacceptable. 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: Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- D. Colors: As indicated on the drawings.

PART 3 – EXECUTION

3.01 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.
- B. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored, and that provision has been made for flashings, and penetrations through sheet metal roofing.

- D. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- E. Examine roughing-in for components and systems penetrating sheet metal roofing to verify actual locations of penetrations relative to seam locations of sheet metal roofing before sheet metal roofing installation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Install flashings and other sheet metal to comply with requirements specified in Section 07 62 00 — Sheet Metal Flashing.

3.03 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under sheet metal roofing to the extent indicated on drawings. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply over entire roof in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply over the entire roof surface.
- B. Install flashings to cover underlayment to comply with requirements specified in Section 07 62 00 — "Sheet Metal Flashing.

3.04 STANDING SEAM METAL ROOF INSTALLATION

- A. General: Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement. Install fasteners, solder, welding rods, 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. Field cutting of sheet metal roofing by torch is not permitted.
- C. Rigidly fasten eave end of sheet metal roofing and allow ridge end free movement due to thermal expansion and contraction. Predrill roofing.
- D. Flash and seal sheet metal roofing with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
- E. Locate and space fastenings in uniform vertical and horizontal alignment.
- F. Install ridge caps as sheet metal roofing work proceeds.
- G. Locate roofing splices over, but not attached to, structural supports. Stagger roofing splices and end laps to avoid a four-panel lap splice condition.
- H. Lap metal flashing over sheet metal roofing to allow moisture to run over and off the material.
- I. Fasteners: Use fasteners of sizes that will not penetrate completely through substrate.
- J. Steel Roofing: Use stainless-steel fasteners.
- K. 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.
- L. 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.
- M. Fascia: Align bottom of sheet metal roofing and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal sheet metal roofing with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.05 FABRICATED SHEET METAL ROOFING INSTALLATION

- A. Fabricate and install work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks, considering temper and reflectivity of metal. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant. Fold back sheet metal to form a hem on concealed side of exposed edges, unless otherwise indicated.
- B. Install cleats to hold sheet metal panels in position. Attach each cleat with two fasteners to prevent rotation.
- C. Nail cleats not more than 12 inches o.c. Bend tabs over nails.
- D. Seal joints as shown and as required for leakproof construction. Provide low-slope transverse seams using cleats where backup of moisture may occur.
- E. 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.
- F. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 – Joint Sealants.
- G. Provide expansion cleats in roof panels that exceed 30 feet in length.
- H. Attach metal pans to substrate with cleats, double- nailed at 12 inches o.c. Install pans reaching from eave to ridge before moving to adjacent pans. Lock each pan to pan below with transverse seam. Before pans are locked, apply continuous bead of sealant to top flange of lower pan. Crimp standing seams by folding over twice so cleat and pan edges are completely engaged.
- I. Loose-lock pans at eave edges to continuous cleats and flanges on back edges of gutters.
- J. Fold over seams after crimping at ridges and hips.

3.06 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.
- B. Install components required for a complete sheet metal roofing assembly including trim, ridge vents and closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- C. 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.
- D. Coordinate installation with installation of sheathing, sheet metal flashing and trim, metal soffit panels and metal fascia.
- E. 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 waterproof and weather-resistant performance.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
- G. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. 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).
- H. Pipe and Penetration Flashing: Form flashing around pipe penetration and sheet metal roofing.
- I. Fasten and seal to sheet metal roofing as recommended by SMACNA.
- J. Install snow guards according to manufacturer's written instructions.
 - 1. Attachment for Standing-Seam Metal Roofing: Do not use fasteners that will penetrate metal roofing, or fastening methods that void metal roofing finish warranty.

3.07 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal roofing within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.08 FIELD QAULTY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements

3.09 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.
- C. Remove temporary protective coverings and strippable films, if any, as sheet metal roofing is installed. On completion of sheet metal roofing installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

END OF SECTION

SECTION 07 42 63
FABRICATED WALL PANEL ASSEMBLIES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fabricated, pre-patinated and perforated sheet metal wall panel assemblies for exterior cladding of steel observation tower.
 - 2. Diamond-shaped copper and zinc panels in multiple sizes.
 - 3. Attachment system using steel clamps and through-bolted connections to steel tube framework substructure.
- B. Related Documents/Sections:
 - 1. Structural drawings
 - 2. Section 05 12 00 – Structural Steel Framing
 - 3. Section 05 50 00 – Metal Fabrications
 - 4. Section 07 92 00 – Joint Sealants

1.02 REFERENCES

- A. ASTM:
 - 1. ASTM A36 – Carbon Structural Steel
 - 2. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing
 - 3. ASTM A653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated
 - 4. ASTM B69 – Rolled Zinc Sheet
 - 5. ASTM B370 – Copper Sheet and Strip for Building Construction
 - 6. ASTM E330 – Structural Performance of Exterior Windows, Curtain Walls, and Doors (applies to cladding under wind loads).
- B. SMACNA – Architectural Sheet Metal Manual

1.03 ACTION SUBMITTALS

- A. Prepare and submit the following in accordance with Section 01 33 00 – Submittal Procedures:
- B. Product Data: Submit manufacturer's Product Datasheet and installation instructions for sheet metal wall panel assemblies, including material, finish, thickness, and dimensions.
- C. Shop Drawings: Layout of diamond-shaped metal wall panels, assembly details, indicating panel sizes, orientation, fastener locations, and substructure connection details.
- D. Closeout Submittals:
 - 1. Warranty: Manufacturer warranty documents; extend coverage to a minimum of 2 years for material defects and finish adhesion, with finish performance limitations clearly noted.
 - 2. Operation and Maintenance Instructions: Submit manufacturer's recommended cleaning and care instructions to properly maintain and prolong the service life of the metal wall panels.
- E. Samples:
 - 1. 6" x 6" sample of each sheet metal wall panel type and finish:
 - a. Copper – "Dirty Penny" preweathered patina finish.
 - b. Zinc – "Roano" and "Baroque" preweathered finishes.
 - 2. Clamp and through-bolt hardware samples.
- F. Certificates: Finish warranty and compliance with ASTM and performance standards.
- G. Maintenance Data: For sheet metal wall panel cleaning and repair.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Company specializing in manufacturing the quality products specified in this section with at least 15 years of documented experience and sufficient capacity to produce the required units within the Project Schedule.
- B. Installer Qualifications:
 - 1. Company specializing in installing the work of this section with at least 5 years of documented experience with comparable size projects.
 - 2. Familiar with the products and the manufacturer's installation methods.
- C. Source Limitation:
 - 1. Ensure all metal sheets from the same producing mill and master slab to minimize visual and chemical variations.
 - 2. All sheets in this section shall be produced by the same manufacturer to protect against variations.
- D. Field Measurements and Coordination:
 - 1. Contractor is responsible for providing final surface dimensions prior to shop drawing submittal.
 - 2. The metal panel manufacturer shall coordinate with the structural steel fabricator to obtain **exact as-built dimensions, locations, and tolerances** of the steel tube framework support structure prior to fabrication of the panels.
 - 3. Any adjustments required to accommodate actual field dimensions, fabrication tolerances, or alignment of the tube framework shall be documented and approved by the design professional prior to panel fabrication.
 - 4. The metal panel manufacturer shall verify all interface dimensions and report discrepancies to the Contractor and structural steel fabricator to prevent misalignment or field modifications during installation.
- E. Field Verification:
 - 1. Field measurements may be performed by the Contractor or designated manufacturer representative.
 - 2. All verified dimensions shall be provided in a format acceptable to the manufacturer before panel fabrication begins.

1.05 PRE-INSTALLATION MEETING AND COORDINATION

- A. General: A mandatory pre-installation meeting shall be conducted before any panel fabrication or erection.
- B. Attendees: Contractor, metal panel manufacturer, structural steel fabricator, and Architect or designated representative.
- C. Objectives:
 - 1. Review panel layouts, dimensions, and orientation.
 - 2. Coordinate attachment points and clamp locations with structural steel members.
 - 3. Confirm tolerances, field measurements, and anticipated expansion allowances.
 - 4. Review mock-up installation requirements and performance verification.
 - 5. Address sequencing, protection, and handling procedures.
- D. Meeting Deliverables:
 - 1. Minutes documenting all decisions, responsibilities, and coordination points.
 - 2. Updated shop drawings and field measurement verification forms.
 - 3. Confirmation of interface tolerances and alignment criteria for fabrication and installation.

1.06 DELEGATED DESIGN

- A. Delegated Design Responsibilities: Design, engineer, and detail perforated metal panel thickness requirements and clamp assemblies, including but not limited to:

1. Provide structural calculations for perforated metal panel thickness requirements to resist applicable live loads, including uniform and concentrated loads, ensuring panels meet ASTM E330 performance criteria.
 2. Connection of perforated metal wall panels to clamps and supporting structure.
 3. Delegated design shall be performed by a Professional Engineer licensed in the State of Ohio, experienced in structural steel connections and metal panel support systems.
- B. Performance Requirements:
1. Clamp assemblies shall transfer design loads from perforated metal wall panels into supporting structure, including:
 - a. Dead load of panels.
 - b. Wind loads as indicated on Structural Drawings.
 - c. Any other applicable live, impact, or imposed loads.
 2. Assemblies shall prevent damage to painted steel tubing, including abrasion, corrosion, or paint finish failure.
 3. Safety Factor: Minimum 2.0 against failure of clamp body, gasket, or fasteners.
- C. Submittals:
1. Signed and sealed calculations; shop and coordination drawings, including perforated panel thickness verification and supporting load calculations.
 2. Shop drawings indicating configuration, dimensions, materials, finishes, gasket details, and fastener specifications.
 3. Coordination drawings showing interface of clamps, perforated panels, and steel tube framework supports.

1.07 MOCKUP

- A. General: Construct mock-up to demonstrate quality of materials, workmanship, detailing, and appearance.
- B. Configuration: Mock-up shall incorporate a minimum of three adjacent perforated sheet metal panels mounted to steel tube framework construction to represent final installation.
1. Minimum of one panel shall show midline connection per drawing detail 3 on Sheet T-A3.
- C. Components to Include:
1. Finish and surface treatment.
 2. Joint details and transitions.
 3. Perforation pattern and orientation.
 4. Attachment hardware and fastening methods.
 5. Edge conditions and terminations.
- D. Location: Construct mock-up at a location acceptable to Architect.
- E. Approved mock-up may become part of the completed Work if undisturbed and acceptable to Architect.
- F. Architect's Evaluation Criteria:
1. Uniformity of manufacturer-applied patina finish across panels while allowing for natural and intended variation.
 2. Consistency of color tone, patterning, and visual depth when viewed both individually and as an array.
 3. Surface integrity — free of streaking, blotches, scratches, abrasions, fingerprints, oil stains, or unintended marks from fabrication, handling, or installation.
 4. Continuity of finish at panel edges, corners, and perforations.
 5. Joint Detailing: Alignment, tolerances and transitions.
 6. Attachment Hardware: Concealment where required, secure fastening, and compatibility with steel tube framework.
 7. Cohesive visual rhythm of panels, perceived uniformity of patina finish from multiple viewing distances, and compatibility with adjacent materials.
 8. Workmanship: General quality of fabrication and installation representing the project standard, including care taken to preserve patina finish during handling and erection.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Receipt:
 - 1. Deliver products in factory sealed and labeled packages.
 - 2. All crates and packaging should be inspected upon delivery for damage. Contact the manufacturer immediately at the time of receipt if any damage is identified. Photographs of any damaged product, including concealed damages must also be provided to manufacturer.
- B. Storage and Transportation: Store metal panels on pallets, off the ground, under weathertight cover, with ventilation to prevent condensation
 - 1. Keep packaging units dry while in secure and locked storage and transport and dry prior to installation.
 - 2. Do not store sheet metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.
 - 3. Crates and packaging: Do not stack crates unless otherwise approved and noted by manufacturer.
 - 4. Panels shall be protected from damage, corrosion, staining, or weathering inconsistent with the approved mock-up.
 - 5. Maintain protective coverings, temporary enclosures, or other approved means to safeguard the patina finish until final acceptance.
 - 6. Panels exhibiting scratches, surface contamination, or finish damage inconsistent with the approved mock-up shall be removed and replaced at no additional cost.
- C. Handling and Installation:
 - 1. Keep products free of oil, grease, mortar, paint, acid, bitumen, drilling dust, dirty water, and other impurities.
 - 2. Do not use adhesive tape on products in areas visible after installation.
 - 3. Do not scribe or mark on products.
- D. Protection: The Contractor is responsible to use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.

1.09 WARRANTY

- A. Manufacturer's Warranty: Manufacturer will warrant its products to be in good quality, free from defects, in conformance with the specification, and when installed in accordance with manufacturer's published installation procedures. Any defaults or defects in material or workmanship resulting solely from the manufacturer shall constitute a warranty claim.
- B. Manufacturer's warranty coverage and failure types includes, but not limited to, the following:
 - 1. Minimum 2-year limited warranty on material defects and finish performance, including corrosion perforation, finish adhesion, and patina stability.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Acceptable Manufacturer: A. Zahner Co., Kansas City, MO.
 - 1. Copper – Preweathered "Dirty Penny" patina.
 - 2. Zinc – Preweathered "Roano" and "Baroque" finishes.

2.02 MATERIALS

- A. Copper Sheet: ASTM B370, preweathered patina finish.
- B. Zinc Sheet: ASTM B69, preweathered finishes as indicated.
- C. Dirty Penny Copper:
 - 1. Material: Copper
 - 2. Sheet Width: Maximum 36 inch

3. Sheet Length: Maximum 120 inch
 4. Sheet Thickness: 24 oz (0.820 mm) (Verification required in delegated design)
- D. Baroque Zinc and Roano Zinc:
1. Material: Zinc
 2. Sheet Width: Maximum 39.4 inch
 3. Sheet Length: Maximum 120 inch
 4. Sheet Thickness: 0.032 inch (0.8 mm) (Verification required in delegated design)
- E. Metal Wall Panel Shapes: Diamond configuration in varied sizes as shown on drawings.
- F. Substructure Tubing: ASTM A500 Grade B, 2-3/8" OD steel hollow tubes, hot-dip galvanized after fabrication.
- G. Fasteners:
1. Through-bolts: Stainless steel, Type 316, with neoprene washers.
 2. Clamps: Custom-fabricated stainless steel with corrosion-resistant finish.

2.03 TUBING CLAMPS

- A. Manufacturer: Subject to compliance with requirements, provide tube clamps fabricated by the panel manufacturer or separate source approved by the panel manufacturer:
- B. Clamp Description:
1. Clamp Type: Custom 'P-shape' gasketed steel tube clamp, designed specifically to attach metal wall panels to 2-3/8 inch (60.3 mm OD) round steel tube framework for secure support.
 2. Configuration: One-piece wraparound with attachment leg ("P-shape") designed to bolt to supporting structure and restrain panels against movement.
 3. Function: Support perforated metal panels on observation tower framing.
 4. Orientation: Clamps to be field-located as indicated on Drawings to align and secure panel assemblies.
- C. Materials:
1. Clamp Body:
 - a. Material: ASTM A36 steel plate or ASTM A1011 hot-rolled steel sheet.
 - b. Shape and dimensions: Fabricated to match tube OD with tolerance for gasketed fit.
 2. Gasket:
 - a. Material: EPDM, neoprene, or UV-resistant elastomeric pad, continuous along clamp contact surface.
 - b. Function: Electrically isolate copper panels from steel clamp to prevent galvanic corrosion. Provide full bearing between clamp and painted tube, preventing abrasion, galvanic action, or paint damage.
 - c. Thickness: Minimum 1/16 inch (1.5 mm).
 3. Fasteners: Bolts, nuts, and washers: ASTM A307 galvanized steel, or stainless steel ASTM F593/F594, as indicated. Provide lock washers or prevailing-torque lock nuts to resist loosening.
- D. Fabrication and Finish:
1. Fabrication: Shop-formed to required "P-shape" geometry; edges ground smooth; corners radiused.
 2. Clamp finish: Stainless steel or corrosion-resistant coating; match panel appearance where visible.
 3. Gasket installation: Continuous along clamp contact area; no voids, folds, or gaps.
- E. Performance Requirements:
1. Clamps shall resist design loads as indicated on structural drawings, including lateral wind loads transmitted through perforated metal wall panel assemblies.
 2. Provide clamp assembly with minimum safety factor of 2.0 against failure of clamp body, gasket, or fasteners.
 3. Clamp-to-tube bearing shall distribute load uniformly without point loading or paint finish abrasion.

4. Galvanic Protection: Clamp design shall prevent direct metal-to-metal contact between copper panels and steel clamps, including at fasteners and attachment points, to eliminate galvanic corrosion potential.

2.04 FABRICATION

- A. Wall panels shall be shop-fabricated with clean, true edges and predrilled bolt holes aligned to shop drawings.
- B. Fabricate pre-finished metal sheets in compliance with the drawing details which include design, dimensions, geometry, metal thickness and other characteristics.
 1. Allow sufficient room for expansion in the material to prevent buckling, damage, and deterioration of the Work.
- C. Factory-formed patina finishes shall be consistent in tone and texture within manufacturer's tolerances.

2.05 FINISHES

- A. Copper Finish: Zahner "Dirty Penny" preweathered patina.
- B. Zinc Finishes: Zahner "Roano" and "Baroque" preweathered patinas.
- C. Clamp and Fastener Finish: Stainless steel with brushed or bead-blast finish.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that supporting structure and steel tube members, within construction tolerances, and free of defects that would impair installation of clamp assemblies.
- B. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protect adjacent surfaces from damage during installation.
- B. Confirm alignment and spacing of steel tube framework supports prior to metal wall panel attachment.

3.03 INSTALLATION

- A. Comply with manufacturer's instructions for assembly, installation, and erection of pre-finished metal sheets and install metal wall panels per manufacturer's instructions and approved shop drawings.
- B. Install metal wall panels in designed diamond layout, ensuring accurate registration of locations, sizes and orientations.
- C. Provide panel attachment methods that allow for thermal expansion and contraction, ensuring fasteners and connections do not restrict movement or cause deformation of perforated metal panels.
- D. Clamp Installation:
 1. Install tube clamp assemblies in accordance with:
 - a. Approved delegated design shop drawings and structural calculations
 - b. Manufacturer's written instructions
 2. Ensure clamps are aligned accurately to maintain panel plane and orientation tolerances:
 - a. Tube centerline alignment: $\pm 1/8$ inch (3 mm)
 - b. Clamp spacing: $\pm 1/8$ inch (3 mm)
 - c. Panel plane alignment: $\pm 1/8$ inch (3 mm) over 10 feet (3 m)
- E. Gasket and Galvanic Isolation: Verify factory-installed gaskets are properly seated and continuous along the clamp contact surface before panel attachment.

1. Ensure no direct metal-to-metal contact occurs between copper panels and steel clamps, including at fasteners or attachment points.
 2. Maintain gasket integrity during installation; avoid folds, gaps, or displacement.
 3. Confirm full bearing of the gasket against tube surface to prevent abrasion or finish damage.
 4. Any damaged or misaligned gaskets shall be replaced prior to panel installation.
- F. Fastening: Secure clamps to supporting structure using specified fasteners and torque values indicated in delegated design submittals.
1. Do not overtighten fasteners, which could compress or damage gaskets and compromise galvanic isolation.
- G. Panel Attachment: Attach metal panels to clamps following manufacturer's instructions, ensuring full gasket coverage and continuous isolation from steel components.
1. Check alignment of panels and clamps after attachment to verify no direct contact occurs between dissimilar metals.
- H. Verification: Inspect each clamp and panel interface for proper gasket seating, continuous contact, and compliance with galvanic isolation requirements.
1. Correct any issues before proceeding to the next panel installation sequence.

3.04 FIELD QUALITY CONTROL

- A. Field inspections shall be performed by the Contractor, manufacturer's representative, or designated quality control personnel to verify compliance with approved shop drawings, delegated design, and manufacturer instructions.
- B. Confirm that installed metal wall panels match approved shop drawings in size, orientation, and layout.
- C. Verify that all P-clamps are installed according to approved delegated design and shop drawings and check that gaskets are properly seated, continuous, and undamaged, ensuring full bearing at all panel-to-clamp interfaces.
- D. Confirm all fasteners are installed, properly tightened to specified torque, and that lock washers or prevailing-torque nuts are engaged. Replace any damaged, missing, or incorrectly installed fasteners.
- E. Any defective, misaligned, or damaged panels, clamps, fasteners, or gaskets shall be corrected or replaced immediately at the Contractor's expense.

3.05 CLEANING AND PROTECTION

- A. Remove protective film from exposed surfaces of metal wall panels promptly upon installation and in accordance with manufacturer's recommendations and with care to avoid damage to finish.
- B. Protect painted steel tube surfaces from damage during clamp installation.
- C. Following installation of steel-to-steel components, promptly clean and touch up abraded, damaged, or uncoated surfaces with same coating system to ensure complete and uniform coverage.
- D. Ensure gaskets remain seated and undisturbed until completion of installation.
- E. Clean exposed surfaces of metal wall panel work promptly after completion of installation. Comply with the recommendations of the metal panel manufacturer.
- F. Maintain installed metal wall panels in a clean condition throughout construction and ensure that cleaning by other trades in proximity to the wall panels does not impart dust or debris on panels. Avoid spilling, dripping, or splattering cleaning solutions onto panels.
- G. Leave installation in condition for acceptance, free of damage or defects.

END OF SECTION

SECTION 07 44 00
CONCRETE FACED INSULATED PANELS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Factory fabricated, concrete faced insulated perimeter wall panels and accessories and installation materials required for a complete system.
- B. Related Requirements:
 - 1. Division 01 - General Requirements: Administrative, procedural, and temporary work requirements.

1.02 REFERENCES

- A. ASTM International:
 - 1. C272 – Water Absorption of Core Materials.
 - 2. C518 – Steady-State Thermal Transmission Properties by Means of Heat Flow Meter Apparatus.
 - 3. C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - 4. D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 - 5. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 6. E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

1.03 PERFORMANCE REQUIREMENTS

- A. Thermal Resistance: Minimum R-value per inch in accordance with ASTM C518.
- B. Compressive Strength: EPS insulation minimum 25 psi per ASTM D1621.
- C. Water Absorption: Maximum 3% by volume per ASTM C272.
- D. Fire Performance: Surface burning characteristics per ASTM E84; Flame Spread $\leq$ 25, Smoke Developed $\leq$ 450.

1.04 ACTION SUBMITTALS

- A. Provide the following submittals in accordance with section 01 33 00 – Submittal Procedures.
- B. Product Data:
 - 1. Provide most recent technical components data sheets describing materials physical properties and include product characteristics, performance criteria, physical size and limitations.
 - 2. Provide manufacturers recommended installation methods
 - 3. Provide manufacturers recommended storage and handling requirements and recommendations.

1.05 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that Insulated Concrete Faced Panel form meets or exceed ASTM C578, Type II.
- B. Test and Evaluation Report: Submit laboratory test reports certifying that the Insulated Concrete Faced Panel Form is in compliance with NFPA 286.
- C. Manufacturers Installation Instructions: Indicate any special instructions.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of insulated concrete-faced panels with minimum 10 years of documented experience.
- B. Installer Qualifications: Installer experienced with work of this Section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's unopened packaging, labeled with manufacturer's name and product identification.
- B. Store materials flat, off the ground, and protected from weather, sunlight, and damage.

1.08 WARRANTY

- A. Provide manufacturer's standard limited warranty for panels.

PART 2 – PRODUCTS

2.01 CONCRETE FACED INSULATED SHEATHING

- A. Concrete Faced Insulated Perimeter Wall Panels:
 - 1. Basis of Design: WallGUARD Concrete Faced Insulated Perimeter Wall Panels by T. Clear Corporation.
- B. Construction:
 - 1. Extruded polystyrene board, ASTM C578, Type IV, rigid, closed cell, with integral high density skin, with integral 5/16 inch thick latex-modified concrete facing.
 - 2. Board Size: 2 x 4 feet x 2-5/16 inches thick.
 - 3. Edges: Tongue-and-groove sides, square ends.
 - 4. thermal resistance: Long term aged R-value of 5 per inch, tested to ASTM C518.
 - 5. Foam compressive strength: Minimum 35 PSI, tested to ASTM D1621.
 - 6. Compressive strength: Minimum 40 PSI, tested to ASTM D 1621.
 - 7. Water absorption: Maximum 0.7 percent by volume, tested ASTM D2842.
 - 8. Water vapor permeance: 0.8, tested to ASTM E96/E96M.
 - 9. Coefficient of lineal thermal Expansion: 3.5×10^{-5} inches per inch x degree F, tested to ASTM D696.
 - 10. Finish: Exposed aggregate, broom, or manufacturer's standard as selected.
 - 11. Color: as selected by Architect.
- C. Accessories:
 - 1. Metal cap flashing: 24 gage galvanized steel J-channel; 2-1/4 inches wide, 4 inch long leg and 2-1/4 inch short leg; prefinished, color to be selected.
 - 2. Adhesives and mechanical fasteners as recommended by manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify substrate conditions are suitable for installation of panels.
- B. Do not begin work until unsatisfactory conditions are corrected.

3.02 INSTALLATION - CONCRETE FACED INSULATED PERIMETER WALL PANELS

- A. Install panels in strict accordance with manufacturer's instructions and approved shop drawings.
- B. Surfaces to Receive Panels: Flat, sound, clean, and free from irregularities and or jagged surfaces.
- C. Provide level and plumb alignment with tight, uniform joints.
- D. Mechanically fasten panels as recommended by manufacturer.
- E. Seal joints watertight with sealant and accessories.

3.03 FIELD QUALITY CONTROL

- A. Inspect installed panels for damage, alignment, and secure attachment.

- B. Replace or repair panels not meeting requirements.

3.04 PROTECTION

- A. Protect completed installation from damage during remaining construction activities.

END OF SECTION

SECTION 07 46 46
FIBER-CEMENT SIDING AND TRIM

PART 1 – GENERAL

1.01 SUMMARY

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Fiber-cement siding and trim.
 - 2. Related flashing, accessories, and fastenings.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 06 10 00 – Rough Carpentry for wood furring, grounds, nailers, and blocking.
 - 2. Section 07 27 00 – Fluid-Applied Air Barrier for barriers under siding.

1.02 ACTION SUBMITTALS

- A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.
- B. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Samples for Initial Selection: Provide 1' x 1' samples with different reveal sizes for the Architect's review.
- D. Samples for Verification: For each type, color, texture, and pattern required.
 - 1. 12-inch-long-by-actual-width Sample of siding.
 - 2. 12-inch-long-by-actual-width Samples of trim and accessories.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of siding and trim, from manufacturer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.
- C. Warranty: Sample of special warranty.
- D. Maintenance Data: For each type of siding and trim and related accessories to include in maintenance manuals.
- E. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish full lengths of siding and trim including related accessories, in a quantity equal to 2 percent of amount installed.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type, color, texture, and pattern of siding and trim, including related accessories, from single source from single manufacturer.
- B. Installer Qualifications: Installer shall be licensed, registered or otherwise acceptable to authorities having jurisdiction to install exterior building products.
- 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 mockups for siding and trim including accessories.
2. Size: 48 inches long by 60 inches high.
3. Include outside corner on one end of mockup and inside corner on other end.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

1.06 COORDINATION

- A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.07 WARRANTY

- A. Special Warranty: Standard form in which manufacturer agrees to repair or replace siding and trim that fail(s) in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking, deforming, and fading.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 2. Fading is defined as loss of color, after cleaning with product recommended by manufacturer, of more than 5 Hunter color-difference units as measured according to ASTM D 2244.
 3. Warranty Period: 30 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 FIBER-CEMENT SIDING AND TRIM

- A. General: Siding made from fiber-cement board that complies with ASTM C 1186, Type A, Grade II; is classified as noncombustible when tested according to ASTM E 136; and has a flame-spread index of 25 or less when tested according to ASTM E 84.
 1. Basis of Design Manufacturer/Product:
 - a. James Hardie Building Products, Inc.
 - b. Product: HardiePanel® Vertical Siding and HardieTrim® Boards.
 2. Acceptable Manufacturers: Subject to compliance with requirements, the following manufacturers are acceptable:
 - a. Louisiana Pacific; LP SmartSide., Nashville, TN
 - b. Allura USA, Houston, TX
- B. Vertical Siding: Manufacturer's panels for board and batten application.
 1. Size: 48 inches wide by 96 inches long
 2. Thickness: 5/16 inch.
 3. Texture: Manufacturer's standard smooth or vertical finish as indicated on drawings.
 4. Color: Winchester Brown, ColorPlus® Technology finish.
 5. Performance:
 - a. ASTM C1186, Type A, Grade II.
 - b. Engineered for HZ5 Climate Zone (freeze-thaw resistant).
 - c. Non-combustible per ASTM E136.
- C. Soffit Panels: Manufacturers Non-Vented Soffit Panel.
 1. Factory sealed on 5 sides.
 2. Thickness: 1/4 inch

3. Basis of Design Manufacturer: Woodtone, Chilliwack, BC; Canada.
 - a. Siding: Woodtone "RusticSeries Lap"
 - b. Substrate: Any of the named manufacturers in this section as coated by Woodtone.

2.02 COATING SYSTEM

- A. Finish Coating System:
 1. Wood Appearance Proprietary Two Coat System.
 2. Factory finish top coating.
- B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.

2.03 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
 1. Provide accessories made from same material as adjacent siding unless otherwise indicated.
- B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated on the Drawings.
- C. Colors for Decorative Accessories: As selected by Architect from manufacturer's full range of industry colors.
- D. Flashing: Provide stainless-steel flashing complying with Section 07 62 00 – Sheet Metal Flashing at window and door heads and where indicated.

2.04 FASTENERS

- A. Fasteners: Nails for Fiber Cement Siding and Engineered Wood Siding with Woodtone RusticSeries Coating: As recommended by fiber cement siding manufacturer.
- B. Wood Framing Fasteners: Stainless steel, as recommended by siding manufacturer.
- C. Metal Framing: Stainless steel, as recommended by siding manufacturer.
- D. Masonry Walls:
 1. Masonry Walls: Aerico Stud Nail, ET&F ASM No.-144-125, 0.14 inch shank by 0.30 inch head by 2 inches long corrosion resistant nails.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding and trim and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.03 INSTALLATION, - TRIM, FASCIA AND MOULDINGS

- A. Install flashing around all wall openings.
- B. Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.

- C. Place fasteners no closer than 3/4 inch and no further than 2 inch from side edge of trim board and no closer than 1 inch from end. Fasten maximum 16 inch on center.
- D. Maintain clearance between trim and adjacent finished grade.
- E. Trim inside corner with single board.
- F. Install single board of outside corner board then align second corner board to outside edge of first corner board.
- G. Allow 1/8 inch gap between trim and siding. Seal gap with high quality, paint-able caulk.
- H. Shim frieze board as required to align with corner trim.
- I. Install fascia over structural subfascia.

3.04 INSTALLATION, PLANK SIDING

- A. General: Comply with siding manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply. Overlap joints to shed water away from direction of prevailing wind.
 - 1. Fasten siding in place, level and plumb. Nail to aligned pattern.
 - 2. Install siding for natural watershed.
 - 3. Position cut ends over bearing surfaces.
 - 4. Install corner strips, closures and trim.
 - 5. Where exposed fasteners are used, touch-up fastener heads with paint to match panel finish color.
- B. Starting: Install a minimum 1/4 inch thick lath starter strip at the bottom course of the wall. Apply planks horizontally with minimum 1-1/4 inches wide laps at the top. The bottom edge of the first plank overlaps the starter strip.
- C. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions. Flash vertical joints.
- D. Align vertical joints of the planks over framing members.
- E. Butt joints must not fall within 4 inches of a stud. Do not nail within 2 inches of the end of planks.
- F. Maintain clearance between siding and adjacent finished grade.
- G. Locate splices at least one stud cavity away from window and door openings.
- H. For proper fastener selection and fastening schedules for various wind load requirements and framing options, refer to the manufacturer's instructions.
- I. Face nail to sheathing.

3.05 INSTALLATION, VERTICAL SIDING (BOARD AND BATTEN)

- A. Install materials in strict accordance with manufacturer's installation instructions.
- B. Block framing between studs where panel siding horizontal joints occur.
- C. Install metal Z flashing and provide a 1/4 inch gap at horizontal panel joints.
- D. Place fasteners no closer than 3/8 inch from panel edges and 2 inches from panel corners.
- E. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.
- F. Install batten boards, trim, and fascias in accordance with manufacturer's instructions using stainless steel finish nails.
- G. Flashing is required over all horizontal protruding and exposed trim.
- H. Maintain clearance between siding and adjacent finished grade.
- I. Specific framing and fastener requirements refer to Tables 2 and 3 in National Evaluation Service Report No. NER-405.

3.06 INCIDENTAL SITE FINISHING

- A. Carefully set exposed nails flush with siding coating.
- B. Touch-up blemished siding materials to match siding color. Apply touch up coating on surfaces and ends cut during installation.
- C. Install joint sealants as specified in Section 07 92 00 – Joint Sealants and to produce a weathertight installation.

3.07 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes providing sheet metal for the following applications:
 - 1. Formed flashing and trim.
 - 2. Formed brake-metal work.
- B. Related Sections:
 - 1. Section 04 22 00 – Unit Masonry for installation of through-wall flashings.
 - 2. Section 06 10 00 – Rough Carpentry for wood nailers, curbs, and blocking; flexible flashing at openings.
 - 3. Section 07 27 26 – Fluid-Applied Membrane Weather Barriers for flexible flashing and perimeter terminations
 - 4. Section 07 92 00 – Joint Sealants for field-applied sheet metal flashing and trim sealants.

1.02 REFERENCES

- A. National Roofing Contractors Association (NRCA): The NRCA Roofing and Waterproofing Manual.
- B. Sheet Metal and Air Conditioning National Association (SMACNA):
 - 1. Architectural Sheet Metal Manual

1.03 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall 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.
 - 1. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
 - 2. Design system capable of withstanding building code requirements for negative wind pressure.
 - 3. Shop or field formed roof membrane termination are not acceptable.
- 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.
- C. Sheet Metal Standard for SMACNA – Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. SPRI Wind Design Standard: Manufacture and install roof edge specialties tested according to ANSI/SPRI ES-1 and conforming to the following:
 - 1. ANSI/SPRI/FM 4435/ES-1 – Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.
 - 2. Design Pressure: As indicated on Drawings.
 - 3. Design Requirements: Manufacturer is responsible for designing units, including anchorage to structural system and necessary modifications to meet specified requirements.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent 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: 120 deg F, ambient; 180 deg F, material surfaces.

- F. Installation Requirements: Fabricator is responsible for installing system, including anchorage to substrate to maintain visual design concepts in accordance with Contract Documents and following installation methods as stipulated in the SMACNA.
1. Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, and profiles of units.
 2. Make modifications only to meet field conditions and to ensure fitting of system components.
 3. Provide concealed fastening wherever possible.
 4. Attachment considerations: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between units and building structure or between components themselves.
 5. Obtain Architect 's approval for connections to building elements at locations other than indicated in Drawings.
 6. Accommodate building structure deflections in system connections to structure.

1.04 ACTION SUBMITTALS

- A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- C. Shop drawings:
1. Fully dimensioned large scale design details showing material profiles, splices, flashing terminations and other jointing details, fastening methods and installation details. Indicate material type, sizes, and weights or gages. Indicate extent of adjacent work specified under other Sections of the Specifications.
 2. Fully detail methods of relieving stresses due to thermal movement, including sealing of expansion seams.
 3. All details bearing dimensions of actual measurements taken at the project.
- D. Selection Samples:
1. Metal sample chips, indicating Manufacturer's full range of finish colors for factory finishes available for selection by Architect.
 2. Manufacturer's sample boards for sealant colors.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested and FM Approvals approved.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Sample Warranty: For special warranty.
- E. Closeout Submittals:
1. Manufacturer's warranties: Include coverage of materials and installation and resultant damage from failure of installation to resist penetration of moisture.

1.06 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Meet with the Owner, Architect and Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
 2. Review methods and procedures related to sheet metal flashing and trim.

3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.07 QUALIFICATIONS

- A. Fabricator and Installer:
 1. Company specializing in work of this Section with minimum 5 years documented experience installing commercial quality work.

1.08 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.
- D. Protect strippable protective covering from exposure to sunlight and high humidity, except to extent necessary for period of installation.

1.09 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Pre-Finished Sheet and Sheet Coil Coating Warranties: Manufacturer's 20 year warranty, for each sheet material, against fading, color change, chalking, peeling, cracking, or delaminating.

PART 2 – PRODUCTS

2.01 EXPOSED SHEET MATERIALS

- A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch thick base metal, shop pre-coated with PVDF coating.
 1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 2. Color: As selected by Architect from manufacturer's full colors.

2.02 SHEET METAL FLASHING WITH DRIP ABOVE OPENINGS

- A. Metal Flashing: Prefinished aluminum, 0.040 in (1 mm) minimum thickness.
- B. Drip Edge:
 1. Integral or mechanically attached
 2. Hemmed and sloped to shed water away from wall face
 3. Minimum projection of 1 in (25 mm) beyond exterior wall surface

2.03 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

2.04 ACCESSORY MATERIALS

- A. Accessories: Provide accessory components required for a complete finished installation.
- B. Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and accessory items as required for a complete system and as recommended by sheet metal manufacturer and fabricator for metal work, unless otherwise indicated.
- C. Fasteners: Provide same metal as sheet metal or other non-corrosive compatible metal recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.
- D. Metal Accessories: Provide cleats, straps, anchoring devices, and similar accessory units as required for installation of work, noncorrosive, size and gauge required for performance.

2.05 FABRICATION

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 1. 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.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabricate non-moving seams in sheet metal with flat lock or butt hairline joints except as otherwise indicated. Fabricate corners mitered, soldered and sealed as one piece. Locate corner joints 2'-0" from corners and intersections. Where soldered flat-lock seams are not possible, use soldered riveted lap seams joints for additional strength.
- C. Fabricate cleats and starter strips of same material as sheet, interlockable with sheet. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
 1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
- D. Fasteners: Use fasteners 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.
 1. Use stainless-steel fasteners.
- E. Seams:
 1. Provide following seam types unless noted or detailed otherwise.
 - a. Flat: Flat lock.
 - b. Corner: Double lock corner
 - c. Standing: Double lock standing lap seam.
- F. Flashing and Counter Flashing:
 1. Fabricate as indicated on Drawings.
 2. Hem exposed flashings on underside 1/2-inch (13-mm); miter and seam corners.
 3. Fabricate vertical faces with bottom edge formed outward 1/4-inch (6-mm) and hemmed to form drip.
 4. Fabricate flashings to allow toe to extend minimum 2-inches (50-mm) over wall surfaces.
- G. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- H. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

- I. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1-inch (25-mm) deep, filled with mastic sealant (concealed within joints).

PART 3 – EXECUTION

3.01 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FLASHING INSTALLATION – GENERAL

- A. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with the SMACNA – Architectural Sheet Metal Manual. Anchor units of work securely in place by methods indicated, providing for thermal expansion of units; conceal 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 weatherproof.
 1. Install units plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction.
 2. Apply asphalt mastic on stainless steel surfaces of units in contact with dissimilar metals.
 3. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
 4. Miter, lap seam and close corner joints with solder. Seal seams and joints watertight.
 5. Install expansion joints at frequency recommended by SMACNA. Do not fasten moving seams such that movement is restricted.
 6. Coordinate with installation of roofing system and roof accessories.
- B. Provide for separation of metal from non-compatible metal or corrosive substrate by coating concealed surfaces at contact location with bituminous coating or other permanent separation as recommended by the sheet metal manufacturer.
- C. Where metal flashing is installed over wood-preserved-treated lumber, install continuous waterproof or felt underlayment as a separator between wood and flashing.
- D. Install starter and edge strips, and cleats before starting installation. Insert flashings into reglets to form tight fit. Seal flashings into reglets with sealant. Anchor units securely in place by methods indicated, providing for thermal expansion. Conceal fasteners and expansion provisions unless otherwise approved by the Architect. Install joint sealants where indicated.
- E. Seal movable non-expansion type joints with joint sealant. Form joints as indicated, when not indicated, in compliance with industry standards to receive joint sealants.
 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 Section 07 92 00 – Joint Sealants.
- F. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- G. 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 or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

3.03 INSTALLATION HEADER FLASHING

- A. Install specified flashing at window heads, piping, vents and all other projections from vertical surfaces where rain water may accumulate. Flashing shall be of continuous length for full width of window head, joints in flashing is not acceptable. Flashing shall extend behind air infiltration barrier a minimum of 3 inches up the wall.
- B. Install thru-wall flashing continuously at all locations indicated, including:
 - 1. Window and door openings
 - 2. Shelf angles
 - 3. Wall terminations
 - 4. Roof-to-wall intersections and parapets
- C. Fasten flashing using corrosion-resistant fasteners; avoid puncturing weatherproof membranes unnecessarily.
- D. Lap seams minimum 2 in (50 mm) and seal with approved exterior-grade elastomeric sealant.
- E. Drip edge must project beyond exterior wall surface to direct water away from the wall.
- F. Form end dams at terminations to prevent water infiltration.
- G. Integrate flashing with air and moisture barrier according to manufacturer recommendations.

3.04 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim 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.
- C. 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

SECTION 07 92 00
JOINT SEALANTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes joint sealants and fillers for the applications specified with the products in this Section and as indicated on Drawings. Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Joint sealants and fillers, interior and exterior including silicone, urethane and latex joint sealants.

1.02 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.03 ACTION SUBMITTALS

- A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit product data including catalog cuts, specification data, installation details, and manufacturer's certificate for each type of sealant required.
- C. Product/Location List: Submit for approval a detailed list of locations where materials will be used, types of sealants which will be used at each location, and names of manufacturers of compounds, primers, and fillers which will be used. Submit manufacturer's certificate attesting that their products comply with specification requirements and are suitable and recommended for the use indicated.
- 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.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and testing agency.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Field-Adhesion Test Reports: For each sealant application tested.
- G. Warranties: Sample of special warranties.

1.05 QUALITY ASSURANCE

- A. Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- C. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- D. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- E. Provide the following upon request:
 - 1. Qualification Data: For qualified Installer.
 - 2. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
 - 3. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
 - 4. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
 - 5. accepted by the Architect.

1.06 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 or are below 40 deg F (5 deg C).
 - 2. When joint substrates are wet.
 - 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.
- B. Apply joint sealants as late as possible in the construction, preceding application of water repellent coatings if any, and painting and following cleaning operations.
- C. Do not install solvent curing sealants in unventilated building spaces.

1.07 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint sealant manufacturer agrees to furnish 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 Silicone Sealants: 20 years from date of Substantial Completion.
 - 2. Warranty Period Urethane Sealants: 5 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 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

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, products which may be incorporated in the work as low-modulus neutral curing silicone sealants include products of the following manufacturers:
 1. Dow Corning Corporation.
 2. Sika Corporation, Construction Products Division
 3. Momentive
 4. Pecora
 5. Tremco Inc.
- B. Subject to compliance with requirements, products which may be incorporated in the work as the other specified sealants include products of the following manufacturers, and others as specified:
 1. BASF Building Systems
 2. USG
 3. Bostik

2.02 JOINT SEALANT 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 joint-sealant manufacturer, based on testing and field experience.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors of Exposed Joint Sealants: Match Architect's samples.

2.03 SILICONE JOINT SEALANTS

- A. Joint Sealer **Type SC** (Silicone, general construction): One-part medium modulus, neutral-cure, synthetic sealant, having a useful life expectancy of at least 20 years, conforming to ASTM C 920, Type S, Grade NS, Class 50, use NT, with a minimum movement capability of ± 50 percent, equal to the following:
 1. Dow Corning, product, "791"
 2. Momentive product, "Silpruf LM SCS 2700"
 3. Pecora, product, "895"
 4. Sika, product, "Sika Sil-C 995"
 5. Tremco, product, "Spectrem 3"
 - a. Staining, ASTM C 1248: None on concrete, marble, granite, limestone, and brick.
 - b. Color: As selected by Architect from manufacturer's standard line of not less than 15 colors.
- B. Joint Sealer **Type SE** (Silicone, Exterior construction): Ultra low-modulus, high-performance, one-part, moisture-curing silicone joint sealant, having a useful life expectancy of at least 20 years, conforming to ASTM C 920, Type S, Grade NS, Class 100/50, Use NT, equal to the following:
 1. Dow Corning, product, "790"
 2. Sika, product "Sika Sil-C 990"
 3. Momentive product "Silopruf LM SCS 2700"
 4. Tremco, product "Spectrem 1"

- a. Staining, ASTM C 1248: None on concrete, marble, granite, limestone, and brick.
 - b. Color: As selected by Architect from manufacturer's standard line of not less than 12 colors.
5. Pecora product "890"
- C. Joint Sealer **Type ST** (Silicone, color Tintable): Multi-component, neutral-curing, nonstaining, low dirt pick up, low-modulus silicone sealant having a useful life expectancy of at least 20 years, conforming to ASTM C 920, Type S, Grade NS, Class 50, Use NT, M, G, A, and O, with a minimum movement capability of +/- 50 percent, equal to the following:
 1. Tremco, product "Spectrem 4-TS"
 - a. Staining, ASTM C 1248: None on concrete, marble, granite, limestone, and brick.
 - b. Color: [Match Architect's custom color] [As selected by Architect from manufacturer's standard line of not less than 70 colors].
 2. Dow Corning product "756SMS"
 3. Mumentive product "Silpruf NB SCS9000"
 4. Pecora, product, "890 FTS"

2.04 URETHANE JOINT SEALANTS

- A. Joint Sealer **Type HL1** (Horizontal-self-Leveling, 1-component): Pouring grade self-leveling modified urethane or neutral cure silicone sealant, ASTM C 920 Uses T and NT, Type S, Grade P, Class 25, with a minimum movement capability of ± 25 percent, equal to the following:
 1. BASF, product, "MasterSeal SL1"
 2. Sika, product, "Sikaflex 1cSL"
 3. Tremco, product "Vulkem 45" / 45 SSL
 4. Pecora product "Urexspan NR-201"
 5. Bostik product "Chem-Calk 955SL"
- B. Joint Sealer **Type HL2** (Horizontal-self-Leveling): Two-part, moisture-curing, low-modulus polyurethane sealant with a tintable base sealant, ASTM C 920, Type M, Grade P, Class 35; Uses T, O, and I, with a minimum movement capability of ± 25 percent, equal to the following:
 1. BASF, product "MasterSeal SL2"
 2. Sika Corp., product, "Sikaflex 2cSL"
 3. Tremco, product, "Vulkem 445SSL"
 - a. Tensile Strength, ASTM D 412: 250 psi (1.7 MPa), at 100 percent elongation.
 - b. Tear Strength, ASTM D 412: 35 pli (6.1 kN/m).
 - c. Adhesion to Concrete, After Water, ASTM C 794: 28 pli (4.4 kN/m)
 - d. Hardness, ASTM C 661: 40 durometer Shore A, minimum.
 - e. Accelerated Weathering, ASTM C 793: Pass.
 - f. Color: As selected by Architect from manufacturer's standard line of 70 colors
 4. Pecora Chemical Corp. product "DynaTrol II-SG"
- C. Joint Sealer **Type P2** (Polyurethane, Multi-component): Low modulus type, Multi-component non-sagging gun-grade polyurethane sealant, conforming to FS TT-S-000227E, Type II, Class A, and ASTM C 920, Type M, Class 25, Grade NS, uses T and NT, with a minimum movement capability of ± 25 percent, equal to the following:
 1. BASF, product "MasterSeal NP2"
 2. Tremco, product "Vulkem 227"
 3. Pecora, product "Dynatred"
 4. Sika, product "Sikaflex 2c NS"

2.05 LATEX JOINT SEALANTS

- A. Joint Sealer **Type AA** (Acrylic acoustical): One component acrylic latex, permanently elastic, non-staining, non-shrinking, non-migrating and paintable, and recommended for sealing interior concealed joints to reduce transmission of air-borne sound.
 1. Tremco, product "Tremco Acoustical Sealant"
 2. USG, product "USG Acoustical Sealant"

3. Pecora, product " AIS-919"
4. Momentive product "RCS20"

B. Joint Sealer **Type AP** (Acrylic latex or siliconized acrylic latex): One component acrylic latex caulking compound, conforming to ASTM C 834 Type P, Grade NF, for use NT; paintable within 24 hours after application, with a minimum movement capability of ± 12.5 percent, equal to one of the following:

1. BASF, product, "Sonolac"
2. Tremco, product, "Tremflex 834"
3. Bostik, product, "Chem-Calk 600"
4. Pecora, product " AC-20+"

2.06 MILDEW-RESISTANT JOINT SEALANTS

A. Joint Sealer **Type SM** (Silicone, Mildew-resistant): One-part. ASTM C 920, Type S, Grade NS, Class 50, for use NT, minimum movement capability of ± 50 percent, and a Shore A hardness of 20, equal to the following:

1. BASF, product "MasterSeal NP 150"
2. Dow Corning, product "786 Mildew-resistant"
3. Momentive product "SCS1700 Sanitary"
4. Tremco, product "Tremsil 200 Sanitary"
5. Pecora, product "898"
6. Sika Sikasil N-Plus

2.07 MISCELLANEOUS JOINT SEALANTS

A. Joint Sealer **Type B** (Butyl): Gun-grade modified butyl and polyisobutylene sealant, conforming to ASTM C-1311, with a movement capability of ± 10 percent or better and a Shore A hardness of 24 to 28, equal to one of the following:

1. Tremco, product "Butyl Sealant"
2. Pecora, product "BC-158"
3. Bostik Chem, product "Chem-Calk 300"

2.08 ACCESSORIES

A. Compressible joint bead back-up: Compressible closed cell polyethylene, extruded polyolefin or polyurethane foam rod complying with ASTM C 1330, Type C, 1/3 greater in diameter than width of joint. Shape and size of compressible back-up shall be as recommended by manufacturer for the specific condition used. Provide one of the following, or equal.

1. Nomaco, Inc., Zebulon, NC, product "Green Rod"
2. Industrial Thermo Polymers Ltd., Brampton, Ontario CN, product "ITP Standard Backer Rod"
3. BASF Construction Systems, product "MasterSeal 920 and 921"
4. W.R. Meadows Inc., Hampshire, IL, product "Sealtight Kool-Rod"

B. Type B: Bi-cellular reticulated, polymeric foam material with a surface skin, nonoutgassing, with a density of between 1.5-3.0 pcf (24-48 kg/cubic meter) per ASTM D1622 and minimum tensile strength of greater than 29 – 38 psi (200 – 267 kPa) per ASTM D1623, and with water absorption less than 0.058 oz./cubic inch (0.10 gm/cc) per ASTM C1016; one of the following:

1. SOFROD; Nomaco, Inc.
2. Soft Backer-Rod; BASF.
3. Titan Foam, Backer Rod Manufacturing

C. Primers: Furnish and install joint primers of the types, and to the extent, recommended by the respective sealant manufacturers for the specific joint materials and joint function.

D. Bond-breaker tape, and temporary masking tape: Of types as recommended by the manufacturer of the specific sealant and caulking material used at each application, and completely free from contaminants which would adversely affect the sealant and caulking materials. Provide self-adhesive tape where applicable.

E. 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 with joint substrates.

- F. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surfaces adjacent to joints to which it is applied.

PART 3 – EXECUTION

3.01 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.

3.02 PREPARATION

- A. General:
 - 1. Weather conditions must be dry and of the temperature, as recommended by sealant manufacturer, during application operations.
 - 2. Surface receiving work of this section must be absolutely dry and dust free. All joints receiving sealant/caulking materials and primers shall be subject to the approval of the sealant manufacturer for proper use of specified materials.
- B. Thoroughly clean all joints, removing all loose mortar, oil, grease, dust, frost, and other foreign materials that will prevent proper adhesion of primers and sealant materials.
 - 1. Clean ferrous metals of all rust and coatings by wire brush, grinding or sandblasting.
 - 2. Remove oil, grease and protective coatings with cleaners recommended by sealant manufacturer.
- C. Prime joint substrates, as recommended in writing by joint-sealant manufacturer, as based on preconstruction joint-sealant-substrate tests or as based upon 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. Verify that joint backing and release tapes are compatible with sealant.
- E. Perform preparation in accordance with ASTM C 804 and C 790 for solvent and latex base solvents, respectively.

3.03 INSTALLATION

- A. General: Conform to SWRI requirements, and sealant manufacturer's written requirements for installation.
- B. Install joint bead back-up in all joints in excess of 5/8-inch depth, and joints that have no back-up therein, placing the joint bead in the joint in a manner that will assure a constant depth 1/8 inch greater than the sealant and caulking material depth tolerances.
 - 1. Set beads into joints continuously, by slightly stretching during placement, to permit compression against sides of joint, without surface wrinkles or buckles.
 - 2. Do not stretch back-up material into joints.
- C. Install bond breaker in joints where shown in the Drawings and wherever recommended by the sealant manufacturer to prevent bond of the sealant to surfaces where such bond might impair the Work.
- D. Apply masking tape or other precautions to prevent migration or spillage of materials onto adjoining surfaces.
- E. Apply urethane sealant and latex caulking materials into joints in accordance with manufacturer's instructions, using mechanical or power caulking gun equipped with nozzle of appropriate size, with sufficient pressure to completely fill the joints.
 - 1. The depth of sealant and caulking materials shall be in accordance with manufacturer's recommendations for the specific joint function, but in no case exceed 1/2-inch in depth, nor less than 1/4-inch, regardless of the joint width.

2. Maintain the outer edge of the sealant and caulking materials, where side faces of joints are in the same plane, back 1/8-inch from the faces.
 3. Apply sealant in continuous beads without open joints, voids or air pockets so as to provide a watertight and airtight seal for the entire joint length.
 4. After placement of the sealant and caulking materials, concave-tool the surfaces to uniform density, using a water-wet tool. Do not use detergents or soapy water for the tooling operations.
 5. Remove the temporary masking tape immediately after tooling, and before the sealant or caulking material has taken initial set.
- F. Take care not to block-off weep tubes or any through wall opening constructed to allow weeping of accumulated water.
- G. Apply pouring self-leveling urethane sealant (Sealant designation HL) into horizontal joints in accordance with manufacturer's instructions, to a level approximately 1/16 inch below adjacent surfaces.
1. Apply sealant without open joints, voids or air pockets so as to provide a watertight and airtight seal for the entire joint length.
 2. After placement of the sealant and caulking materials, concave-tool the surfaces to uniform density, using a water-wet tool. Do not use detergents or soapy water for the tooling operations.
 3. Remove the temporary masking tape immediately after tooling, and before the sealant has taken initial set.

3.04 INSTALLATION PRE-FORMED FOAM SEALANTS

- A. General: The joint configuration and the joint surfaces shall be as detailed in the Drawings and in accordance with the current material Tech Data available from the Manufacturer. Field measurements of the depth and width of the joint shall be supplied to manufacturer before material is ordered.
- B. Joint sealer/expansion joint material to be installed in strict accordance with the manufacturer's instructions.
1. Installed each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material.
 2. Install in manner to provide seal continuity at ends, turns and intersections of joints.
 3. Provide additional wet seal joints where required by manufacturer.
- C. Remove all strip-off waste materials and excess foam sealant from site immediately upon completion of work.

3.05 CLEANING

- A. Clean all surfaces of adjacent surfaces which have been marked or soiled by the work of this Section, removing all excess sealant and caulking materials with solvents which will not damage the surfaces in any way.

3.06 PROTECTION

- A. During the operation of sealant work, protect the work of other trades against undue soilage and damage by the exercise of reasonable care and precautions. Repair or replace any work so damaged and soiled.

3.07 SCHEDULE

- A. General: Seal joints indicated and all interior and exterior joints, seams, and intersections between dissimilar materials.
- B. Sealant Colors:
1. Colors for Sealant Types "P2" and "HL2": Match colors furnished by the Architect, or match other building materials as directed. Should such custom colors not be available from the approved manufacturer, except at additional charge, provide all such colors at no change in Contract Sum.
 2. Colors for Sealant Types "BP2", "P1", "HL1", "HT", "SC", "SE", and "SM": As selected by the Architect from manufacturer's standard colors.
 3. Color for Sealant Types "AA" and "AP": White.
 4. Color for Sealant Type "B": Black.

5. In concealed installation, and in partially or fully exposed installation where so approved by the Architect, standard gray or black sealant may be used.

C. Exterior joints (Listed by primary building material abutting sealant joints):

1. Concrete (including precast):

JOINT CONDITION	SEALANT TYPE
Concrete foundation walls to abutting concrete, and other non-bituminous pavements, steps, platforms, and ends of ramp, (horizontal joints):	HL2
Concrete slabs on grade to abutting non-bituminous pavements (horizontal joints, including pedestrian traffic surfaces)	HL2
Concrete to concrete saw cut and tooled control and isolation joints in horizontal surfaces including pedestrian traffic surfaces	HL1 or HL2
Concrete and non-bituminous sloped (5% to 12%) pavement ramps (horizontal joint) at abutting concrete or masonry foundation walls	HT
Concrete to all items which penetrate exterior concrete walls, including, but not necessarily limited to, door frames, louver frames, pipes, vents, and similar items	P1

2. Exterior Masonry:

JOINT CONDITION	SEALANT TYPE
Masonry to masonry, expansion and control joints	SE
Masonry to abutting non-porous materials (painted metals, anodized aluminum, mill finished aluminum, PVC, glass, and similar materials):	SE or ST
Masonry to abutting masonry, stone or concrete:	SE
Masonry to all items which penetrate exterior masonry walls, including, but not necessarily limited to, door frames, louver frames, pipes, vents, and similar items	SE or ST

3. Exterior Metal:

JOINT CONDITION	SEALANT TYPE
Metal to Metal	SE or ST
Bedding of metal thresholds	B

D. Interior joints (Listed by primary building material abutting sealant joints):

1. Interior Concrete:

JOINT CONDITION	SEALANT TYPE
Concrete to concrete: horizontal walkable surfaces:	HL2
Concrete to all items which penetrate concrete walls, including, but not necessarily limited to, door frames, louver frames, pipes, vents, and similar items	SC

2. Interior Masonry: * Includes interior side of exterior masonry walls

JOINT CONDITION	SEALANT TYPE
Masonry to masonry control joints	P2
Masonry to Gypsum Board	SC
Masonry to all items which penetrate masonry walls, including, but not necessarily limited to, window frames, door frames, louver frames, and similar items:	SC
Masonry to all pipes, conduit and vents which penetrate non-rated masonry walls	SC

3. Gypsum Board:

JOINT CONDITION	SEALANT TYPE
Gypsum board to metal or wood trim:	AP
Gypsum board to masonry:	SC
Gypsum board to interior door and window frames, penetrating conduits and piping, light-fixtures, electrical cover plates, building specialty items, ductwork, grilles, supply diffusers, faucets, piping, escutcheon plates and similar items	AP
Gypsum board to plumbing fixtures:	SM

4. Interior Metal:

JOINT CONDITION	SEALANT TYPE
Metal to metal	SC
Bedding of metal thresholds	B

5. Interior Floor Drains:

JOINT CONDITION	SEALANT TYPE
Floor drains to concrete slab	P2
Floor drains to resilient sheet flooring	P2

END OF SECTION

SECTION 08 11 00
METAL DOORS AND FRAMES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes standard hollow metal doors and frames.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 04 22 00 – Concrete Unit Masonry
 - 2. Section 08 71 00 – Door Hardware
 - 3. Section 09 91 00 – Painting: Field painting doors and frames.
 - 4. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.02 REFERENCES

- A. SDI standards:
 - 1. SDI-108-23 Recommended Selection and Usage Guide for Standard Steel Doors
 - 2. SDI-117-23 Manufacturing Tolerances for Standard Steel Doors and Frames
 - 3. SDI-124-22 Maintenance of Standard Steel Doors and Frames
- B. ANSI Standards:
 - 1. ANSI/UL 1784-2020 Air Leakage Test of Door Assemblies
 - 2. ANSI/SDI A250.3-2019 Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
 - 3. ANSI/SDI A250.4-2024 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings
 - 4. ANSI/SDI A250.6-2024 Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
 - 5. ANSI/SDI A250. 8-2023 Specifications for Standard Steel Doors and Frames
 - 6. ANSI/SDI A250.10-2020 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
 - 7. ANSI/SDI A250.11-2022 Recommended Erection Instructions for Steel Frames (Formerly SDI-105)
 - 8. ANSI A115.18 Hardware Preparation in Steel Doors and Steel Frames
 - 9. ANSI/DHI A115.IG Installation Guide for Doors and Hardware

1.03 PERFORMANCE REQUIREMENTS

- A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.20 deg Btu/F x h x sq. ft. when tested according to ASTM C518.

1.04 ACTION SUBMITTALS

- A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings: Show the following:
 - 1. Elevations of each door and frame design.
 - 2. Frame details for each frame type including dimensioned profiles.
 - 3. Details and locations of reinforcement and preparations for hardware.
 - 4. Details of each different wall opening condition.
 - 5. Details of anchorages, accessories, joints, and connections.
 - 6. Details of conduit and preparations for power, signal, and control systems.
 - 7. For doors with thresholds, show coordination of threshold height and the threshold's integral seal with position of the bottom edge of the door for a proper closure and seal of the bottom of the opening.

- C. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings.

1.05 QUALITY ASSURANCE

- A. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.
- B. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- C. Provide doors and frames complying with ANSI/SDI 100 "Recommended Specifications for Standard Steel Doors and Frames" and as specified.
- D. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.
- E. Doors shall be provided to conform with the Americans with Disabilities Act Accessibility Guidelines (ICC A117.1 – Accessible and Usable Buildings and Facilities). These requirements supersede Technical Specifications in this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect; otherwise, remove and replace damaged items as directed.
- C. Doors and frames shall be stored vertically under cover. The units shall be placed on at least 4" high wood sills or in a manner that will prevent rust or damage. The use of non-vented plastic or canvas shelters that can create a humidity chamber shall be avoided.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.07 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.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, products of the following manufacturers are acceptable:
 - 1. Steelcraft, ALLEGION, Cincinnati, OH
 - 2. Ceco Door; ASSA ABLOY, Chicago, IL
 - 3. Curries, ASSA ABLOY, Mason City, IA
 - 4. Pioneer Industries, ASSA ABLOY, Carlstadt, NJ
 - 5. Republic Doors and Frames, ALLEGION, McKenzie, TN

2.02 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- H. Glazing: Comply with requirements in Section 08 80 00 – Glazing.
- I. 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.

2.03 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 galvanized coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - g. Core: Polyurethane or polystyrene insulation, meeting ASTM C1363 thermal performance.
 - 1) U-Factor: Not greater than 0.50 BTU/hr·ft²·°F.
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A60 galvanized coating.
 - b. Full profile welded construction.

2.04 FRAME ANCHORAGE

- A. Floor Anchors:
 - 1. At bottom of jamb use 0.053 inch thick steel clip angles welded to jamb and drilled to receive two 1/4 inch floor bolts.
 - 2. Form jamb anchors of not less than 0.042 inch thick steel unless otherwise specified.
 - 3. Where floor fills occur, provide extension type floor anchors to compensate for depth of fill.
- B. Jamb Anchors:
 - 1. Locate anchors on jambs near top and bottom of each frame, and at intermediate points not over 24 inches apart.
 - 2. Anchors set in masonry: Use adjustable anchors designed for friction fit against the frame and for extension into the masonry not less than 10 inches. Use one of following type:
 - a. Wire loop type of 3/16 inch diameter wire.
 - b. T-shape or strap and stirrup type of corrugated or perforated sheet steel.
 - 3. Anchors for frames set in prepared openings:
 - a. Steel pipe spacers with 1/4 inch inside diameter welded to plate reinforcing at jamb stops or hat shaped formed strap spacers, 2 inches wide, welded to jamb near stop.

- b. Drill jamb stop and strap spacers for 1/4 inch flat head bolts to pass thru frame and spacers.
 - c. Two piece frames: Subframe or rough buck drilled for 1/4 inch bolts.
- 4. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

2.05 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.06 FINISHES

- A. Shop Painting:
 - 1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before the application of the shop coat of paint.
 - 2. Clean, treat, and paint exposed surfaces of fabricated hollow metal doors and frames, including galvanized surfaces plus back prime exterior hollow metal door frames.
 - 3. Apply shop primer that complies with ANSI A250.10 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied topcoats. Apply primer immediately after surface preparation and pretreatment.
 - 4. Apply shop coat of prime paint of not less than 1.0 mil without runs, smears, or bare spots ready to receive field applied paint.
- B. Factory Priming for Field-Painted Finish: Apply shop primer that complies with ANSI A250.10 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied primer and topcoats. Apply shop primer immediately after surface preparation and pretreatment.
- C. Field finishing of doors and frames is specified in Section 09 91 00 – Painting, and consists of primer plus two finish coats per the finish schedule.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Hollow Metal Frames: Install frames plumb, level, rigid and in true alignment as recommended in ANSI/SDI A250.11, "Recommended Erection Instructions for Steel Frames" and A115.IG, "Installation Guide for Doors and Hardware". Frames shall be fastened to the adjacent structure so as to retain their position and stability.
 - 1. Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.

2. In existing concrete or masonry construction, provide at least three completed opening anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with masonry anchorage devices.
 3. In-place concrete or masonry construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 4. For CMU walls: Welded wire anchors at 16 inches o.c. maximum, 3/16 inch diameter wire, not less than 8 inches long, arranged to embed in mortar joint.
 5. Grouting: Not permitted. Frames shall be anchored mechanically.
 6. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 7. Installation Tolerances: Adjust hollow metal 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. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
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.
 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Installation of hardware items shall be in accordance with the hardware manufacturer's recommendations and templates. A115.IG, "Installation Guide for Doors and Hardware" and ANSI/SDI A250.6, "Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames" shall be consulted for other pertinent information.

3.02 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.03 ADJUSTING AND CLEANING

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08 31 13
ACCESS DOORS AND FRAMES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes access doors and frames to be provided for the project.
 - 1. Access panels shown on Drawings or otherwise required shall be furnished under this Section, and installed by the trade responsible for the construction in which they will be installed.
 - 2. Access panels required by the Work of Mechanical Divisions – 21, 22, 23, and Division 26 – Electrical shall be furnished by the trade whose work requires access through otherwise solid construction, and installed by the trade responsible for the construction in which they will be installed.
- B. The Work of this Section includes, but is not limited to, the following:
 - 1. Access panels for locations as required by the work of the General Contract. Access panels include the following types:
 - a. Wall access panels.
 - b. Ceiling access panels.
- C. Related Sections:
 - 1. Section 04 22 00 – Unit Masonry
 - 2. Section 09 29 00 – Gypsum Board: Installation of access panels into drywall assemblies.

1.02 ACTION SUBMITTALS

- A. Prepare and submit the following in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit product data for each type of access door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.
- C. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.
- D. Information and Review Submittals:
 - 1. Product Data: Manufacturer's product data sheets, specifications and installation instructions.
 - 2. Schedule: Submit Schedule of all access panels to be furnished hereunder, indicating locations for each size and type of access door.
 - a. Ensure that all of the types/styles of panels and frames specified herein can be furnished by the manufacturer submitted.
 - b. Prior to submitting schedule, coordinate with the work of Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating and Air Conditioning and Division 26 – Electrical and meet with the Architect to determine exact quantities and locations required for the installation of access panels.
 - 3. Shop drawings: Large scale details of access doors, indicating all sizes, gages and thickness; provide complete installation details, coordinated to the specific receiving conditions.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Acudor Products Inc., Cedar Grove, NJ.
 - 2. Karp Associates Inc., Maspeth, NY.

3. Nystrom Products Company, Minneapolis, MN.
 4. Williams Brothers Corporation of America, Front Royal, VA.
- B. Single Source: All work of this Section shall be produced by a single manufacturer, unless otherwise approved by the Architect.

2.02 ACCESS PANELS – FOR NON- RATED CONSTRUCTION

- A. For non-rated wall and ceiling surfaces (service and non-public areas): Flush panel door type meeting the following requirements:
1. Description: Flush, insulated access panels, with self-closing, self-latching door and ex-posed trim.
 2. Locations: Masonry and gypsum wallboard wall and ceiling surfaces.
 3. Dimensions: As required for access to equipment.
 4. Door: Flush panel door with a 2-inch thick core of mineral fiber insulation enclosed in 20-gauge sheet metal.
 5. Frame type:
 - a. For gypsum board walls and ceilings: 16 gage galvanized bonderized steel frame, with 22 gage galvanized steel drywall bead.
 6. Door: Flush panel door as follows:
 - a. Typical all wall types, except tile: 16 gage galvanized bonderized steel.
 7. Hinge:
 - a. Typical: Concealed spring hinge enabling door to open 175 degrees and permit removal of door from frame.
 - b. Panels greater than 24 by 36 inches: Flush continuous piano hinge with stainless steel pin.
 8. Latching/Locking Device: Key operated cylinder lock
 - a. Provide 2 keys per lock; access door locks shall be master-keyed alike.
 9. Acceptable Products:
 - a. Milcor Standard Flush Door - DW
 - b. Acudor DW-5040 series.
 - c. Karp KDW series.
 - d. Nystrom NW series.
 - e. Williams WB-PL series.
- B. Provide stainless steel access doors and frames in high moisture areas and in all wall locations.

2.03 FABRICATION

- A. General: Provide access door assemblies manufactured as integral units ready for installation.
- B. Steel Access Doors: Fabricate units of continuous welded steel construction. Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
1. Provide special sized access doors where required or requested.
- C. Frames:
1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame for steel frames.
 2. Provide trimless carbon steel frames with drywall bead for installation in gypsum wallboard assembly, furnish perforated frames with drywall bead, securely attached to perimeter of frames, in size to suit thickness of gypsum panels indicated. Provide mounting holes in frames to attach frames to metal framing in drywall construction.

2.04 FACTORY FINISHING

- A. Panel assemblies fabricated from stainless steel: N°. 4 satin finish.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's instructions for installation of access doors. Coordinate installation with work of other trades.
- B. Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.
- C. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- D. Install access doors flush with adjacent finish surfaces or recessed to receive finish material
- E. Adjust doors and hardware after installation for proper operation.
- F. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 36 13
SECTIONAL OVERHEAD GARAGE DOORS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes insulated sectional overhead garage doors with carriage house style design.
- B. Related Sections:
 - 1. Section 05 50 00 – Metal Fabrications (supporting steel).
 - 2. Division 26 – Electrical: Electrical service and connections for powered operators and accessories.

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
 - 3. ASTM E283 – Standard Test Method for Determining Rate of Air Leakage.
 - 4. ASTM E330 – Standard Test Method for Structural Performance.
 - 5. ASTM C518 – Standard Test Method for Thermal Transmission Properties.
- B. DASMA 102 – Specification for Sectional Garage Doors.
- C. NFRC 102 – Procedure for Determining U-Factor.
- D. ANSI/DASMA 108 – Standard for Sectional Overhead Garage Door Safety..

1.03 ACTION SUBMITTALS

- A. Prepare and submit the following in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: Manufacturer's specifications, installation instructions, operation, and maintenance data for the following:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation details and methods.
 - 4. Operation and maintenance data.
- C. Shop Drawings: Include elevations, construction details, installation requirements, and coordination with opening requirements.
- D. Samples: Provide 2" x 2" samples of composite cladding/overlay finishes and glass selections.
- E. Certificates: Installer certification as authorized Clopay dealer.
- F. Warranty: Manufacturer's published warranty documents.

1.04 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide sectional overhead doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
 - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure (velocity pressure) as required by Code but not less than 20 lbf/sq. ft. acting inward and outward.
- B. Operation-Cycle Requirements: Provide sectional overhead door components and operators capable of operating for not less than 10,000 cycles.

- C. Air Infiltration: ≤ 0.40 cfm/ft² at 25 mph (per 2015 IECC).
- D. R-Value: ≥ 20.4 (per ASTM C518). U-factor per NFRC 102.
- E. Operation Cycles: 10,000 minimum; option for 20,000 with high-cycle springs.

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing sectional garage doors with minimum 10 years documented experience.
- B. Installer Qualifications: Company specializing in installing the types of products specified in this section, with two years of documented experience, and approved by door manufacturer..
- C. Regulatory Requirements: Comply with applicable state and local building codes, including wind load requirements.
- D. Source Limitations: Obtain sectional overhead doors through one source from a single manufacturer.
 - 1. Obtain operators and controls from sectional overhead door manufacturer.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards.
- B. Store products indoors in manufacturer's or fabricator's original containers and packaging, with labels clearly identifying product name and manufacturer. Protect from damage..

1.07 WARRANTY

- A. Manufacturer's Limited Warranty: Provide Clopay standard warranty for Canyon Ridge Series doors covering materials and workmanship.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer: Clopay Corporation, Mason, OH
 - 1. Product: Canyon Ridge® Carriage House (5-Layer) Collection.
- B. The Basis of Design establishes the required standard of quality, performance, and appearance. Products by other manufacturers may be considered in accordance with Section 01 25 00 – Substitution Procedures, provided they demonstrate compliance with the requirements of this Section and maintain the design intent.

2.02 SECTIONAL OVERHEAD GARAGE DOORS

- A. General:
 - 1. Design doors to withstand positive and negative wind loads as calculated in accordance with applicable building code and detailed in structural documents.
 - 2. Counterbalance Type: Torsion spring counterbalance mechanism.
 - a. Sized to weight of door. Helically wound, coated oil tempered, or galvanized torsion spring mounted on a steel shaft. Cable drum of die cast aluminum with high strength galvanized aircraft cable. Minimum 7 to 1 safety factor.
 - b. Spring Type: Optional High Cycle Spring, 20,000 cycles.
- B. Door Construction:
 - 1. Sections: Composite cladding and overlays adhered to base door constructed of foamed in place Intellicore polyurethane core construction between exterior and interior steel skins.

2. Exterior Steel Skins: Formed from flush commercial or drawing quality steel sheet, hot-dip galvanized per ASTM A 924/A 924M and ASTM A 653/A 653M, pre-painted with primer and baked-on polyester topcoat.
 3. Interior Steel Skins: Formed from roll formed commercial or drawing quality steel sheet, hot-dip galvanized per ASTM A 924/A 924M and ASTM A 653/A 653M, pre-painted with primer and baked-on polyester topcoat.
 4. Section Joints: Sections formed to create weather tight tongue-in-groove meeting joint with thermal break.
 5. Reinforcing: Galvanized and primed steel reinforcement located under each hinge location, pre-punched for hinge attachment.
 6. Door Stiles: Galvanized steel end stiles and center stiles, pre-punched for easy hinge attachment.
 7. Handles: Black powder coated, hot-dipped galvanized step plate and lift handle (2 sets on doors over 10 ft wide) to comply with DASMA 116.
 8. Insulation: 2 inch thick CFC-free polyurethane foam, factory injected, fully bonded.
 9. Cladding: Composite material molded from authentic wood grain patterns.
 10. Overlay: Composite trim, factory bonded in carriage house patterns.
- C. Thermal Performance: Calculated in accordance with DASMA TDS-16.
1. R-value: 20.4 (per ASTM C518).
 2. U-factor: As tested per NFRC 102.
 3. Air Infiltration: ≤ 0.3 cfm/ft² at 25 mph (ASTM E283).
- D. Hardware:
1. Hinges: Heavy-duty 14-ga galvanized steel.
 2. Rollers: 10-ball bearing nylon rollers with sealed races.
 3. Track: 2-inch commercial-grade galvanized steel with adjustable brackets.
 4. Springs: Oil-tempered torsion springs, cycle life 10,000 minimum; optional 20,000 cycles.
 5. Weatherseals: Replaceable flexible vinyl bottom seal; factory-installed perimeter seals.
- E. Finish:
1. Composite cladding and overlays available in factory-stained faux wood tones (Walnut, Medium, Slate, Black, or White finish).
 2. Interior face in standard white baked-on polyester finish.

2.03 ELECTRICAL OPERATOR

- A. Manufacturer: LiftMaster® Elite Series or approved equal, UL 325 listed.
- B. Drive Type: Heavy-duty, industrial-grade trolley or jackshaft type, matched to door weight and frequency of operation.
- C. Motor:
1. Horsepower: Minimum 3/4 HP to 1 HP for oversized or insulated doors.
 2. Voltage: 115 VAC, 60 Hz, single-phase.
 3. Duty cycle: Continuous. Thermal overload protection included.
- D. Controls: Wall-mounted push-button station with open/close/stop functions.
1. Integral receiver with MyQ® smart control technology for wireless operation via mobile device.
 2. Optional key switch, keyless entry, or remote transmitters.
 3. Automatic time close feature programmable in 1-second increments.
- E. Safety Devices:
1. Photoelectric safety sensors, UL 325 compliant, mounted no more than 6 inches above floor.
 2. Automatic reversing feature upon contact or obstruction.
 3. Manual emergency release for power outage.
 4. Safe-T-Bracket® installed on bottom brackets.
- F. Accessories:
1. Weather kits (header/perimeter)
 2. Battery backup unit (optional).

3. Surge protector.
4. LED lighting system with motion detection.

2.04 ACCESSORIES

- A. Decorative Hardware: Hinges, handles, and straps as indicated.
- B. Weather-Protection Accessories: Additional perimeter seals and header seals for enhanced air and water infiltration control.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify substrates, framing, and openings are square, plumb, and level. Confirm headroom and sideroom clearances.
- B. Confirm clearances for tracks, headroom, and side room per manufacturer's requirements.

3.02 INSTALLATION

- A. Install products in accordance with approved shop drawings and manufacturer's printed instructions. Install in proper relationship with adjacent construction. Test for proper operation and repeat until satisfactory results are obtained.
- B. Coordinate installation of electric operators with Division 26.

3.03 OPERATOR

- A. Install operator in accordance with manufacturer's instructions and UL 325 requirements.
- B. Coordinate with Division 26 for electrical service.
- C. Operator Mounting:
 1. Trolley type: Secure to ceiling or structural framing aligned with door centerline.
 2. Jackshaft type: Mount to sidewall near torsion shaft, with chain or direct coupling.

3.04 ELECTRICAL REQUIREMENTS

- A. Power Supply: Provide dedicated circuit sized for operator motor load.
 1. Branch circuit protection per NFPA 70 (NEC).
 2. Disconnect switch located within sight of operator.
- B. Conduits and Wiring: Electrical raceways, junction boxes, and wiring provided under Division 26.
 1. Low-voltage control wiring furnished and installed in accordance with operator manufacturer's instructions.
 2. Coordinate routing for photo eyes, push-button stations, and remote devices.
- C. Connections: Division 26 trades to provide final electrical connections.
 1. Installer to test for correct rotation, limit setting, and safety device operation.

3.05 ADJUSTING AND CLEANING

- A. Adjust tracks, springs, and operators for proper balance and performance.
- B. Verify weather seals provide tight closure.
- C. Clean door surfaces; remove protective films and construction debris.

3.06 FIELD QUALITY CONTROL

- A. Verify operator wiring, safety sensor function, and automatic reversal in accordance with UL 325.
- B. Test emergency manual release.

3.07 DEMONSTRATION AND TRAINING

- A. Demonstrate door operation and maintenance procedures to Owner's personnel.
- B. Demonstrate MyQ® connectivity to Owner's mobile device or building system.

END OF SECTION

SECTION 08 51 13
ALUMINUM WINDOWS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Aluminum framed operable windows, complete with thermal insulated glazing in CMU wall.
- B. Related Sections:
 - 1. Section 07 92 00 – Joint Sealants for system perimeter sealant.
 - 2. Section 08 80 00 – Glazing: Materials and installation.

1.02 PERFORMANCE REQUIREMENTS

- A. Provide aluminum window systems that comply with the following performance criteria when tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-17 (North American Fenestration Standard, NAFS) and other standards as noted:
 - 1. Minimum Performance Class: AW
 - 2. Minimum Performance Grade: PG 50
- B. Wind Loads: Provide windows, 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," 6.4.2, "Analytical Procedure," whichever are more stringent.
 - 1. Deflection of framing members in a direction normal to wall plane is limited to 1/175 of clear span or 3/4 inch, whichever is smaller, unless otherwise indicated.
 - 2. Static-Pressure Test Performance: Provide window system that does not evidence material failures, structural distress, failure of operating components to function normally, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.
 - a. Test Pressure: 150 percent of inward and outward wind-load design pressures.
 - b. Duration: As required by design wind velocity; fastest 1 mile (1.609 km) of wind for relevant exposure category.
- C. Dead Loads: Provide framing members that do not deflect an amount which will reduce glazing bite below 75 percent of design dimension when carrying full dead load.
 - 1. Provide a minimum 1/8-inch (3.18-mm) clearance between members and top of glazing or other fixed part immediately below.
- D. Live Loads: Provide window system, including anchorage, that accommodate the supporting structures' deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.
- E. Thermally Broken Construction: Provide systems that isolate aluminum exposed to exterior from aluminum exposed to interior with a material of low thermal conductance.
- F. Air Infiltration: Provide window system with permanent resistance to air leakage through glazing and frame areas of not more than 0.30 cfm/sq. ft. for operable windows when tested according to ASTM E 283 at a static-air-pressure difference of 6.2 lbf/sq. ft. and with an interior seal.
- G. Water Penetration: Provide windows that do not evidence water leakage through fixed glazing and frame areas when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward-acting wind-load design pressure as defined by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," but not less than 12.00 lbf/sq. ft. Water leakage is defined as follows:

1. Uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.
- H. Thermal Movements: Provide windows, including anchorage, that accommodates thermal movements of systems and supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, and other detrimental effects.
 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- I. Structural-Support Movement: Provide window systems that accommodate structural movements including, but not limited to, sway and deflection.
- J. Condensation Resistance: The glass to center CRF, when tested to AAMA Specification 1503, shall not be less than 62_{frame} and 68_{glass} (low-e)
- K. Average Thermal Conductance: Provide windows with average U-values of not more than 0.43 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.1.
- L. Dimensional Tolerances: Provide framing system that accommodate dimensional tolerances of building frame and other adjacent construction.

1.03 ACTION SUBMITTALS

- A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- C. Shop Drawings: Submit shop drawings for fabrication and installation of aluminum windows and associated components of the work including the following:
 1. Include fully dimensioned typical and special unit plans and elevations, sections at 1/2-inch scale and details at 3-inch scale or larger, and the following information:
 - a. Tolerances.
 - b. Profiles of members.
 - c. Anchorage system.
 - d. Connections and fasteners.
 - e. Provisions for expansion and contraction.
 - f. Flashings and drainage.
 - g. Finishes.
 - h. Glazing.
 - i. Interface with building construction.
 2. Include setting drawings, templates, and directions for the installation of anchor bolts and other anchorages installed as a unit of work under other sections.
- D. Samples: Submit material and finish samples required for the work:
 1. Samples showing type and color of painted aluminum finish, on 12 inch long sections of extrusions and on 6 inch square sheets.

1.04 INFORMATIONAL SUBMITTALS

- A. Maintenance Data: Furnish written instructions to Owner describing recommended materials and methods for proper maintenance.
- B. Test Reports: Furnish manufacturer's written test reports substantiating products meet or exceed performance requirements specified herein.
- C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Provide aluminum windows manufactured by a single firm, providing single-source responsibility for all components of the work.
- B. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing window systems similar to those required for this Project and who is acceptable to manufacturer.
 - 1. Engineering Responsibility: Prepare data including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- C. Standard of Quality:
 - 1. The specifications and drawings show and define the essential minimum requirements for quality of materials, construction, finish and overall installation.
 - 2. Minor variations in construction techniques between manufacturers will be permitted, providing specified standards of materials, design, function, dimension, configuration, strength, quality and performance are met.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Pack, deliver, handle, store and protect materials from damage in accordance with AAMA Curtain Wall #10. "Care and Handling of Architectural Aluminum" recommendations.
 - 1. Remove paper type wrappings when unloading.
 - 2. Store materials inside the buildings whenever possible in clean, dry ventilated areas free of dust or corrosive fumes.
 - 3. Stack members vertically or on edge, shim between components to provide water drainage and ventilation. Protect with adequate coverings, placed to provide water drainage and ventilation. Protect with adequate coverings, placed to provide adequate air circulation.
 - 4. During installation, protect materials from lime, mortar, run-off from concrete and copper, weld splatter, acids, roofing materials, solvents and abrasive cleaner.
 - 5. Do not incorporate damaged materials into the work.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.08 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components that fails in materials or installation within the specified warranty period. Failures include, but are not limited to, the following:
 - 1. Structural failures including, but not limited to, excessive deflection.
 - 2. Failure of system to meet performance requirements.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Water leakage through fixed glazing and frame areas.
- C. Warranty Periods:
 - 1. Labor and Material: Two (2) years from date of Substantial Completion.
 - 2. For metal finishes: Ten (10) years from Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Basis of Design: Contract Documents are based on products and systems specified to establish a standard of quality. Other named acceptable manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
 - 1. Kawneer Company, Inc. – 8225TL Thermal Windows
 - a. Thermal, factory-glazed, projected units.
 - b. Dual thermal break construction with poured and debridged urethane
 - c. 2-1/4 Inch frame depth
- B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include those indicated below.
 - 1. EFCO Corporation – Series 450X Thermal Window
 - 2. Tubelite Inc. – Series 400CW Thermal Windows
 - 3. YKK AP America Inc. – YES 450 TU Thermally Broken Operable Window
 - 4. Wausau Window and Wall Systems – 3250-H Series
 - 5. TRACO (a division of Kawneer) – NX-300 Series.

2.02 MATERIALS AND ACCESSORIES

- 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 B 209 (ASTM B 209M).
 - 2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B221, 6063-T5 or T6 alloy and temper, extruded.
 - 3. Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).
 - 4. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Steel Reinforcement: Complying with ASTM A 36 (ASTM A 36M) for structural shapes, plates, and bars; ASTM A 611 for cold-rolled sheet and strip; or ASTM A 570 (ASTM A 570M) for hot-rolled sheet and strip.
- 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. Structural Silicone Sealant: Type recommended by sealant and system manufacturers that complies with ASTM C 1184 requirements, is compatible with system components with which it comes in contact, and is specifically formulated and tested for use as a structural sealant.
 - 1. Color: As selected by Architect from manufacturer's full range of colors.
 - 2. Tensile Strength: 100 psi (689.5 kPa) minimum.
 - 3. Provide sealant with modulus of elasticity that will not allow movement of more than 25 percent of joint width, unless less movement is required by structural-sealant-glazed systems' design.
- E. Secondary Sealant: For use as weatherseal, compatible with structural silicone sealant and other system components with which it comes in contact, and that accommodates a 50 percent increase or decrease in joint width at the time of application when measured according to ASTM C 719.
 - 1. Color: Dark.
- F. Glazing as specified in Section 08 80 00 – Glazing.
- G. Sealants and joint fillers for joints at perimeter of windows as specified in Section 07 92 00 – Joint Sealants.
- H. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.
- I. Fasteners: Non-magnetic stainless steel, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum components.

- J. Concealed Flashing: Dead-soft stainless steel, 26 gage minimum, or extruded aluminum, 0.062 inch minimum, of an alloy and type selected by manufacturer for compatibility with other components.
- K. Trim and Accessories: As required to complete the work, finish to match aluminum framing finish. Finish after fabrication, unfinished exposed edges at holes and trim terminations are not acceptable.
- L. Brackets and Reinforcements: Manufacturer's high-strength aluminum units whenever possible; otherwise, non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A123.
- M. Masonry Inserts: Cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A123.

2.03 WINDOW FRAMING SYSTEM

- A. Thermal Break: High-performance polyurethane poured and debridged or structural polyamide strut.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action
- E. Hardware:
 - 1. Operable units: Manufacturer's standard cam locks, hinges, or roto operators as applicable.
 - 2. Provide limit devices as required for safety and code compliance.

2.04 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.
 - 1. Fabricate components that, when assembled, have the following characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Physical and thermal isolation of glazing from framing members.
 - d. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - e. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- B. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- C. Prefabrication: Complete fabrication, assembly, finishing, and other work before shipment to project site. Disassemble components only as necessary for shipment and installation.
 - 1. Do not drill and tap for surface-mounted hardware items until time of installation at project site.
 - 2. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work in manner which prevents damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.
- D. Welding: Comply with AWS recommendations to avoid discoloration; grind exposed welds smooth and restore mechanical finish.
- E. Reinforcing: Install reinforcing as necessary for performance requirements; separate dissimilar metals with bituminous paint or other separator which will prevent corrosion.
- F. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.
- G. Fasteners: Conceal fasteners wherever possible.

2.05 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. High-Performance Organic Coating Finish: AA-C12C42R1x and the following:
 - 1. Polyvinylidene fluoride finish coating containing not less than 70% of "Kynar 500" or "Hylar 5000" fluorocarbon resin specially formulated for spray application to extrusions and preformed aluminum metal shapes. Remove die markings, scratches, abrasions, dents and other blemishes before applying finish. Coating films shall be uniform and visibly free from flow lines, streaks, blisters, sags or other surface imperfections in the dry-film state on all surfaces.
 - 2. Thickness:
 - a. Fluoropolymer 2-Coat Coating System: Minimum 1.2 mil total dry film thickness (0.25 mil primer +/- 0.05 mil and 1.0 mil topcoat).
 - b. Coating Performance Criteria: Meets or exceeding AAMA 2605.
 - 3. Color: Selected by Architect from manufacturer's full range.
- C. Finish Application:
 - 1. Apply high performance organic coatings to all exposed exterior surfaces of glazed aluminum window components.
 - 2. Adhesion and Compatibility Testing: Test samples of aluminum coatings on aluminum will be required for compatibility and adhesion testing of all sealants proposed for use on framing components. Refer to Section 07 92 00 – Joint Sealants.
 - 3. Appearance of Finished Work: During production, maintain large size color range samples for use in comparing against production material. Variations in appearance of abutting or adjacent pieces are acceptable if they are within the range of approved samples. Noticeable variations in the same piece are not acceptable.
- D. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Field Measurements: Take field measurements and coordinate the preparation of shop drawings and fabrication, to ensure proper fitting of work.
- B. Examine substrates, supporting structure and installation conditions. Do not proceed with erection until satisfactory conditions have been corrected.
- C. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

- A. Install the windows in accordance with manufacturer's instructions and approved shop drawings.
- B. Do not install component parts which are observed to be defective, including warped, bowed, dented, abraded or broken. Remove and replace members which have been damaged during installation or thereafter before time of acceptance.
- C. Do not cut or trim component parts during erection, in a manner which would damage finish, decrease strength, or result in a visual imperfection or a failure in performance of the work.
- D. Apply a bituminous coating or other permanent separator on concealed contact surfaces of dissimilar materials, before assembly or installation to prevent corrosive or electrolytic action.
- E. Install component parts plumb, level, and true to line, without warp of framing members. Anchor securely in place, separating aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials. Use erection equipment which will not mar or stain finished surfaces and will not damage component parts.
- F. Anchor component parts securely in place by bolting, or other permanent mechanical attachment system, which will comply with performance requirements and permit movement as required.
- G. Install glazing as specified in Section 08 80 00 – Glazing.

3.03 ADJUSTING, CLEANING AND PROTECTION

- A. Adjust operable units for smooth, proper operation. Replace damaged components.
- B. Clean completed system, inside and out, promptly after erection and installation of glazing. Remove excess glazing and joint sealants, dirt, and other substances from aluminum surfaces.
- C. Institute protective measures and other precautions required to assure that windows will be without damage or deterioration, other than normal weathering, at time of acceptance.
- D. Immediately before acceptance of the work, clean the aluminum windows thoroughly, inside and out. Prepare a "Cleaning and Maintenance Manual" listing types of cleaning compound, cleaning methods, sealants and glazing materials used for cleaning, repair and maintenance of work and turn over to Owner upon completion of the work.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Mechanical and electrified door hardware
 - 2. Electronic access control system components
 - 3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
- B. Related Sections:
 - 1. Section 06 10 00 – Rough Carpentry'
 - 2. Section 07 92 00 – Joint Sealants' for sealant requirements applicable to threshold installation specified in this section.
 - 3. Section 08 11 00 – Metal Doors and Frames
 - 4. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
 - 5. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

- A. UL LLC:
 - 1. UL 10B - Fire Test of Door Assemblies
 - 2. UL 10C - Positive Pressure Test of Fire Door Assemblies
 - 3. UL 1784 - Air Leakage Tests of Door Assemblies
 - 4. UL 305 - Panic Hardware
- B. DHI - Door and Hardware Institute:
 - 1. Sequence and Format for the Hardware Schedule
 - 2. Recommended Locations for Builders Hardware
 - 3. Keying Systems and Nomenclature
 - 4. Installation Guide for Doors and Hardware
- C. NFPA – National Fire Protection Association:
 - 1. NFPA 70 – National Electric Code
 - 2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
 - 3. NFPA 101 – Life Safety Code
 - 4. NFPA 105 – Smoke and Draft Control Door Assemblies
 - 5. NFPA 252 – Fire Tests of Door Assemblies
- D. ANSI - American National Standards Institute:
 - 1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
 - 2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
 - 3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
 - 4. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

- A. Prepare the submittals in this article in accordance with Section 01 33 00 – Submittal Procedures.
 - 1. Prior to forwarding submittals:

- a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.
 - b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
- B. Action Submittals:
 1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
 2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
 3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
 4. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Section detail at door and threshold showing coordination of door bottom with threshold seal.
 - 2) Door Index: door number, heading number, and Architect's hardware set number.
 - 3) Quantity, type, style, function, size, and finish of each hardware item.
 - 4) Name and manufacturer of each item.
 - 5) Fastenings and other pertinent information.
 - 6) Location of each hardware set cross-referenced to indications on Drawings.
 - 7) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 8) Mounting locations for hardware.
 - 9) Door and frame sizes and materials.
 - 10) Degree of door swing and handing.
 - 11) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
 5. Key Schedule:
 - a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.

- d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
 - 1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 - 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
 - 1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Final approved hardware schedule edited to reflect conditions as installed.
 - d. Final keying schedule
 - e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
 - f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
- E. Inspection and Testing:
 - 1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
 - a. Fire door assemblies, in compliance with NFPA 80.
 - b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

- A. Qualifications and Responsibilities:
 - 1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 - 2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
 - 3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
 - 4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- B. Certifications:

1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
 2. Smoke and Draft Control Door Assemblies:
 - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
 - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
 3. Electrified Door Hardware:
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
 4. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.
- C. Pre-Installation Meetings:
1. Keying Conference:
 - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.
 2. Pre-installation Conference:
 - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Inspect and discuss electrical roughing-in for electrified door hardware.
 - d. Review sequence of operation for each type of electrified door hardware.
 - e. Review required testing, inspecting, and certifying procedures.
 - f. Review questions or concerns related to proper installation and adjustment of door hardware.
 3. Electrified Hardware Coordination Conference:
 - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks
 - a) 10 years
 - 2) Closers
 - a) 30 years
 - b. Electrical Warranty
 - 1) Locks
 - a) 3 years

1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available

product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

- A. Fabrication:
 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
 2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 CONTINUOUS HINGES

- A. Manufacturers:
 1. Scheduled Manufacturer:
 - a. Ives
 2. Acceptable Manufacturers:
 - a. Select
 - b. Best
- B. Requirements:
 1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
 2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
 3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
 4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
 5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
 6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
 7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.04 ELECTRIC POWER TRANSFER

- A. Manufacturers:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin EPT-10
 2. Acceptable Manufacturers and Products:
 - a. Securitron CEPT-10
 - b. Precision EPT-12C
- B. Requirements:
1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
 2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.05 MORTISE LOCKS

- A. Manufacturers and Products:
1. Scheduled Manufacturer and Product:
 - a. Schlage L9000 series
 2. Acceptable Manufacturers and Products:
 - a. Accurate 9000/9100 series
 - b. Best 45H series
- B. Requirements:
1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
 2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
 3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
 4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
 5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
 6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 7. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches. Provide motor based electrified and motor based latch retraction locksets that comply with the following requirements:
 - a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
 - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
 - c. Low maximum current draw – maximum 0.4 amps (Lever control) and maximum 2.0 amps (Latch retraction) to allow for multiple locks on a single power supply.
 - d. Low holding current (Lever control or latch retraction) – maximum 0.01 amps to produce minimal heat, eliminate "hot levers" in electrically locked applications and motorized latch retraction applications, and to provide reliable operation in doors that provide minimal ventilation and air flow.
 - e. Connections – provide quick-connect Molex system standard.
 8. (OPTION Key Override) Provide locks with a key override feature built into the chassis that allows the outside key to retract the deadbolt and/or latchbolt, overriding the inside thumbturn when it is being held in the locked position - where the XL13-439 option is specified in the hardware sets.
 9. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

- a. (OPTION Vandlgard) Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
- b. Lever Design: <INSERT LEVER DESIGN>.

2.06 OFFLINE CONTROLLER

A. Manufacturer and Product:

- 1. Scheduled Manufacturer and Product:
 - a. Schlage CTE Engage Controller
- 2. Acceptable Manufacturers and Products:
 - a. No Substitute

B. Requirements:

- 1. Provide an offline single opening controller UL 294 listed and compatible with the Schlage Engage Application. Include a multi-technology reader kit.
- 2. Provide interfaces for a multi-technology credential reader, powered and dry output relays for strike, alarm, and auxiliary function, and with wireless communication capability.
- 3. Provide offline controller with the following power options:
 - a. Power Over Ethernet (POE)
 - 1) .5A at 12 VDC for up to 500 feet.
 - 2) 1.5A at 24 VDC for up to 500 feet.
 - b. 12 VDC in 2A at 12 VDC for up to 500 feet.
 - c. 24 VDC in 2A at 24 VDC for up to 500 feet.
- 4. Provide offline controller with the following communication standards:
 - a. Bluetooth low energy version 4.2.
 - b. 2.4 GHz Wi-Fi (IEEE 802.11b/g/n).
 - c. WPA2, WPA, WEP, 802.1x (PEAP).
 - d. Transport Layer Security (TLS) version 12.
 - e. Advanced Encryption Standard (AES) 256-bit.
- 5. Provide offline controller with the following signal inputs:
 - a. One Schlage MT11-485 or MT15-485 reader.
 - b. Request to Enter (REN).
 - c. Request to Exit (REX).
 - d. Remote Release – hardwired.
 - e. Door Position Switch (DPS).
 - f. Reader tamper (TAMP).
- 6. Provide offline controller with the following signal outputs:
 - a. Card Reader 0.3A at 12 VDC for up to 500 feet.
 - b. Locking mechanism: 2A at 30 VDC max.
 - c. Auxiliary: 2A at 30 VDC max.
 - d. Alarm: 2A at 30 VDC max.
- 7. Provide offline controller with the following with operating temperatures between -31 F (-35 C) to 151 F (66 C).
- 8. Provide offline controller with the following on board database:
 - a. up to 5,000 users
 - b. up to 2,000 audits (FIFO)
 - c. up to 16 Time Zones
 - d. up to 32 Holiday Schedules
 - e. up to 16 Schedules (lock & unlock)
- 9. Provide offline controller with the following connectivity options:
 - a. Apple or Droid smart phone – Bluetooth updates to CTE.

- b. Wi-Fi access point – automatic daily updates (one time per day) if connected to Wi-Fi.
- C. Provide offline controller with "No-Tour" with MT20W enrollment reader and Schlage 1K smart credentials (13.56 MHz).

2.07 POWER SUPPLIES

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. Schlage/Von Duprin PS900 Series
 - 2. Acceptable Manufacturers and Products:
 - a. Securitron BPS series
 - b. Security Door Controls 600 series
- B. Requirements:
 - 1. Provide power supplies approved by manufacturer of supplied electrified hardware.
 - 2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
 - 3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
 - 4. Provide power supplies with the following features:
 - a. 12/24 VDC Output, field selectable.
 - b. Class 2 Rated power limited output.
 - c. Universal 120-240 VAC input.
 - d. Low voltage DC, regulated and filtered.
 - e. Polarized connector for distribution boards.
 - f. Fused primary input.
 - g. AC input and DC output monitoring circuit w/LED indicators.
 - h. Cover mounted AC Input indication.
 - i. Tested and certified to meet UL294.
 - j. NEMA 1 enclosure.
 - k. Hinged cover w/lock down screws.
 - l. High voltage protective cover.

2.08 CYLINDERS

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. Schlage Everest
 - 2. Acceptable Manufacturers and Products:
 - a. No Substitute
- B. Requirements:
 - 1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
 - 2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. Patented Open: cylinder with interchangeable core with open keyway.
 - 3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
 - 4. Nickel silver bottom pins.

2.09 KEYING

- A. Scheduled System:

1. New factory registered system:
 - a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Requirements:
 1. Construction Keying:
 - a. Replaceable Construction Cores.
 - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - a) 3 construction control keys
 - b) 12 construction change (day) keys.
 - 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
 2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
 - b. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
 - d. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.
 - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 - e. Quantity: Furnish in the following quantities.
 - 1) Master Keys: 6.
 - 2) Change (Day) Keys: 3 per cylinder/core that is keyed differently
 - 3) Key Blanks: Quantity as determined in the keying meeting.

2.10 DOOR CLOSERS

- A. Manufacturers and Products:
 1. Scheduled Manufacturer and Product:
 - a. LCN 4040XP series
 2. Acceptable Manufacturers and Products:
 - a. Corbin-Russwin DC8000 series
 - b. Sargent 281 series
- B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Closers shall be capable of being upgraded by adding modular mechanical or electronic components in the field.

2.11 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.12 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
 - a. Glynn-Johnson
2. Acceptable Manufacturers:
 - a. Rixson
 - b. Sargent

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.13 DOOR STOPS AND HOLDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - 2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco
- B. Provide door stops at each door leaf:
 - 1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
 - 2. Where a wall stop cannot be used, provide universal floor stops.
 - 3. Where wall or floor stop cannot be used, provide overhead stop.
 - 4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.14 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Zero International
 - 2. Acceptable Manufacturers:
 - a. Reese
 - b. Legacy
- B. Requirements:
 - 1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
 - 2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
 - 4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.15 SILENCERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - 2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco
- B. Requirements:
 - 1. Provide "push-in" type silencers for hollow metal frames.
 - 2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
 - 3. Omit where gasketing is specified.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Where on-site modification of doors and frames is required:
 - 1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
 - 2. Field modify and prepare existing doors and frames for new hardware being installed.
 - 3. When modifications are exposed to view, use concealed fasteners, when possible.
 - 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in article 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
 - 3. Furnish permanent cores to Owner for installation.

- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Connections to panel interface modules, controllers, and gateways.
 - 6. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- M. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Section 07 92 00 – Joint Sealants.'
- P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- S. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 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.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.05 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.06 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

- B. Discrepancies, conflicting hardware, and missing items are to 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.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

HARDWARE GROUP NO. 01

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	STOREROOM LOCK	L9080T 06A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A	A	ZER

DOORS REQUIRE SPECIAL 3/8 INCH UNDERCUT FOR ADA TYPE THRESHOLD.

HARDWARE GROUP NO. 02

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK	L9092TEU 06A CON 12/24 VDC	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER
1	EA	CONTROLLER	CTE-MT15-485-B	B	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC	LGR	SCE

DOORS REQUIRE SPECIAL 3/8 INCH UNDERCUT FOR ADA TYPE THRESHOLD.

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. DURING DAYLIGHT HOURS, DOOR CAN BE UNLOCKED BY CONTROLLER TO ALLOW FOR USE OF RESTROOM. KEY OVERRIDE AVAILABLE FOR EMERGENCY INGRESS. FREE EGRESS AT ALL TIMES

HARDWARE GROUP NO. 03

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	EU MORTISE LOCK W/ INDICATOR XL13-346	L9492TEU 06A L583-363 XL13-346 DM CON 12/24 VDC	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER
1	EA	CONTROLLER	CTE-MT15-485-B	B	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC	LGR	SCE

DOORS REQUIRE SPECIAL 3/8 INCH UNDERCUT FOR ADA TYPE THRESHOLD.

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. DURING DAYLIGHT HOURS, DOOR CAN BE UNLOCKED BY CONTROLLER TO ALLOW FOR USE OF RESTROOM. KEY OVERRIDE AVAILABLE FOR EMERGENCY INGRESS. FREE EGRESS AT ALL TIMES

HARDWARE GROUP NO. 04

PROVIDE EACH RU DOOR(S) WITH THE FOLLOWING:

<u>QTY</u>	<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
ALL REQUIRED HARDWARE BY OVERHEAD DOOR MANUFACTURER				

HARDWARE GROUP NO. 05

PROVIDE EACH RU DOOR(S) WITH THE FOLLOWING:

<u>QTY</u>	<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
EXISTING DOOR, FRAME & HARDWARE TO REMAIN				

END OF SECTION

SECTION 09 29 00
GYPSUM BOARD

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Interior gypsum board faced ceiling assemblies, and supplementary items necessary for installation as follows.
 - 1. Gypsum board ceiling systems including:
 - a. Joint treatment materials
 - b. Trim accessories
 - 2. Gypsum board finishing schedule - Level of Finish for gypsum board surfaces.
 - 3. Drywall trim and finishing (joint tape and compound treatment).
- B. Related Sections/Drawings:
 - 1. "Board Types by Location" on the drawings.
 - 2. Section 09 22 16 – Non-Structural Metal Framing: Wall framing, ceiling suspension systems, wall furring, etc.
 - 3. Section 09 91 00 – Painting: Paint coatings on gypsum board.

1.02 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 for definitions of terms not defined in this Section or in other referenced quality standards.
- B. Damage: Stored or installed paper faced gypsum board materials not specifically manufactured as "moisture-resistant products" shall be classified as defective and nonconforming Work if they have been exposed to wetness or dampness at any time prior to Substantial Completion or if they exhibit evidence of active or dormant mold or mildew.

1.03 REFERENCE STANDARDS

- A. In addition to requirements shown or specified, comply with applicable provisions of following for design, materials, fabrication, and installation of component parts:
 - 1. GA 216 – Application and Finishing of Gypsum Board by Gypsum Association.
 - 2. GA 214 – Recommended Levels of Gypsum Board Finish by Gypsum Association.

1.04 ACTION SUBMITTALS

- A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.
- B. Product Data: Manufacturer's technical literature for each product and system indicated.
 - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

1.05 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- C. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.
- D. Qualification Data:

1. For manufacturer and installer.
2. For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
3. Architect may waive Submittal of Qualification Data for Manufacturers listed in this Section.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years' experience with successful production of products and systems similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 5 years, and with sufficient production capability, facilities and personnel, to produce required Work.
 1. Source Limitations: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards. Provide all components of each shaft wall assembly from a single manufacturer.
- B. Installer Qualifications:
 1. Experience: Installer with not less than 5 years' experience in performing specified Work similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 5 years and with sufficient production capability, facilities, and personnel to produce required Work.
 2. Supervision: Installer shall maintain a competent supervisor who is at Project site during times specified Work is in progress that is experienced in installing systems similar to type and scope required for Project.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Reference: Gypsum Association GA-801: Handling and Storage of Gypsum Products.
- B. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.
- C. Store materials inside under cover and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.
- D. Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal corner beads and other trim from being bent or damaged.
- E. Protect gypsum board panels to prevent damage to edges, ends, and surfaces.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with requirements of ASTM C840 or recommendations of gypsum board manufacturer whichever more stringent, for environmental conditions before, during and after application of gypsum board.
- B. Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 degrees F. Do not exceed 95 degrees F when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent finishing materials from drying too rapidly.
- D. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
 1. If Contractor chooses to install gypsum panels before areas are enclosed and conditioned, he does so entirely at his own risk. Damaged panels shall be removed and new panels installed at Contractor's expense and will not be deemed cause for additional time.
- E. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- F. Provide adequate lighting and ventilation during installation and joint finishing treatment.

1.09 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 – PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include those listed under gypsum board products:
 1. Manufacturers:
 - a. United States Gypsum Company (USG)
 - b. National Gypsum Company, LLC
 - c. CertainTeed Gypsum Corp
 - d. Georgia-Pacific Gypsum
- B. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

2.02 GYPSUM BOARD PRODUCTS

- A. Sizes: Maximum lengths and widths available that will minimize short edge-to-short edge butt joints and to correspond to support system indicated.
- B. Typical Paper-Faced Gypsum Board Products:
 1. Paper-Faced Type X Gypsum Board:
 - a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
 - b. Description: Noncombustible fire-resistant gypsum core with paper surfacing on face, back, and long edges; tapered long edges; 5/8 in. thick.
 - c. Manufacturers and Products:
 - 1) United States Gypsum Company (USG); Sheetrock Firecode X Gypsum Panels, or Sheetrock Brand EcoSmart Firecode X Panels.
 - 2) National Gypsum Company, LLC; Gold Bond Fire-Shield Gypsum board.
 - 3) CertainTeed Corporation; Type X Drywall Panel.
 - 4) Georgia-Pacific Gypsum LLC; ToughRock Fireguard X Gypsum Board.
 2. Abuse-Resistant Paper-Faced Gypsum Board:
 - a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
 - b. Description: Specially formulated, noncombustible, gypsum core with heavy liner paper on back and smooth, heavy abrasive-resistant face paper on face and long edges; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; 5/8 in thick.
 - c. Manufacturers and Products:
 - 1) United States Gypsum Company (USG); Sheetrock Brand AR Firecode X Panels or Sheetrock Brand Glass-Mat Panels Mold Tough AR Firecode® X.
 - 2) National Gypsum Company; Gold Bond XP Hi-Abuse Gypsum Board.
 - 3) CertainTeed Corporation; Extreme Abuse Resistant Drywall.
 - 4) Georgia-Pacific DensArmor Plus Fireguard Abuse-Resistant Interior Panels.

2.03 TRIM ACCESSORIES

- A. Paper Faced Metal Trim: Trim members conforming with ASTM C 1047 is required. Provide galvanized steel laminated with paper trim designed for concealed metal and for application without mechanical fastening, unless otherwise specified; sizes compatible with thickness of drywall.
- B. Typical Drywall Trim Accessories:
 - 1. Material Quality Standard: ASTM C 1047.
 - 2. Description: Trim profile fabricated of paper-faced galvanized or aluminum-coated steel sheet; of required size for gypsum board thickness.
 - 3. Manufacturers:
 - a. United States Gypsum Company (USG)
 - b. MarinoWare
 - c. Phillips Manufacturing.
 - d. ClarkDietrich Industries, Inc.
 - 4. Trim Products:
 - a. Cornerbead:
 - 1) Purpose: For protecting outside (external) and inside corners.
 - 2) Basis of Design: ClarkDietrich Paper-Faced Corner Bead and Paper-Faced Inside Corner Bead.
 - b. L-Trim:
 - 1) Purpose: For protecting exposed edges of gypsum board where gypsum board terminates.
 - 2) Basis of Design: ClarkDietrich Paper-Faced L-Trim.
 - c. Control Joint:
 - 1) Description: One-piece trim formed with V-shaped slot, with removable strip covering slot opening.
 - 2) Purpose: For conditions requiring expansion and contraction stresses of large areas of gypsum board to be relieved.
 - 3) Basis of Design: ClarkDietrich 093 Zinc Control Joint.

2.04 FASTENERS

- A. Limitations: Nails and staples are not permitted.
- B. Metal Framing Screws: Screw fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten metal framing and furring members securely to substrates involved; complying with recommendations of gypsum board manufacturers for applications indicated.
- C. Gypsum Board Screws:
 - 1. Material Quality Standards:
 - a. Metal Framing Members less than 0.03 in (0.75 mm) Thick: ASTM C 1002, Type S.
 - b. Metal Framing Members from 0.033 in to 0.112 in (0.79 mm to 2.9 mm) Thick: ASTM C 954, Type S-12.
 - 2. Product Description - Standard Applications: Bugle head, self-drilling, self-tapping, steel screws with Phillips-head recess of size, holding power, and other properties recommended by respective gypsum board manufacturer; minimum 1 in (25 mm) long; with corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
 - 3. Product Description - High Moisture / Humidity Applications: Bugle head, self-drilling, self-tapping, stainless steel screws with Phillips-head recess of size, holding power, and other properties recommended by respective gypsum board manufacturer; for use at high moisture areas such as Kitchens, Showers and Tub Enclosures, Saunas, Steam Rooms, and Pool Enclosures.
- D. Miscellaneous Fasteners: For conditions not indicated, fasteners shall be type, finish, size, and holding power recommended by respective gypsum board manufacturer and conditions.

2.05 JOINT TREATMENT MATERIALS

- A. Joint Compound: ASTM C475, board manufacturer's standard ready-mixed, low-VOC joint compounds with no detectable amounts of crystalline silica based on NIOSH Method 7500.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose joint compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose joint compound.
- D. Setting Type Joint Compound for Gypsum Board: Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated.
 - 1. Where setting-type joint compounds are indicated as a taping compound only or for taping and filling only, use formulation that is compatible with other joint compounds applied over it.
 - 2. For pre-filling gypsum board joints, use formulation recommended by gypsum board manufacturer.
 - 3. For topping compound, use sandable formulation.
- E. Drying-Type Joint Compounds: Factory-prepackaged vinyl-based products complying with the following requirements for formulation and intended use.
 - 1. Ready-Mix Formulation: Factory-premixed product.
 - 2. Taping compound formulated for embedding tape and for first coat over fasteners and flanges of corner beads and edge trim.
 - 3. Topping compound formulated for fill (second) and finish (third) coats.
 - 4. Lightweight Joint Compound: Specifically formulated to reduce airborne dust while sanding.
 - a. Basis of Design: ProForm Lite Ready Mix Joint Compound with Dust-Tech as manufactured by National Gypsum, or equal products of the other named manufacturers.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
 - 1. Verify rough-in utilities and blocking is in proper position.
- B. Do not proceed with installation until deficiencies are corrected and surfaces to receive gypsum board are acceptable.
- C. Protrusions of framing, twisted framing members, or unaligned members must be repaired before installation of gypsum board is started.

3.02 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Suspended Gypsum Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hanger wires at spacing required to support ceilings and that hangers will develop their full strength.

3.03 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. United States Gypsum Company (USG); Gypsum Construction Handbook, if no other installation quality standard applies to condition.
 - 2. Respective Manufacturer's written installation instructions.
 - 3. Accepted submittals.
 - 4. Contract Documents.
 - 5. Gypsum Association GA 216.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.04 INSTALLATION OF GYPSUM BOARD ASSEMBLIES

- A. Gypsum Board Installation Requirements: Comply with ASTM C840.
 - 1. Do not proceed with gypsum board installation until blocking, framing, bracing, and other supports for subsequently applied work have been reviewed, installed, and accepted by the Architect.
 - 2. Do not install gypsum board until thermal and acoustical insulation, and other work concealed by gypsum board have been installed.
- B. Install interior gypsum board in the following locations:
 - 1. Wallboard Type X: Vertical and horizontal surfaces unless otherwise indicated.
- C. Control Joints: Install control joints at locations indicated on Drawings, in specific locations approved by Architect for visual effect and according to the following:
 - 1. Where different substrates occur at ceilings and walls.
 - 2. Where control joints occur in substrates at ceilings and walls.
 - 3. Where ceilings and walls abut inside face of exterior walls.
 - 4. Where L, U, or T shaped ceiling configurations are joined.
 - 5. Where less-than-ceiling-height door frames occur on walls more than 30 feet in length; extend control joints from top of frame up to ceiling at corner of hinge side of door
- D. Isolation from Building Structure: Isolate gypsum board assemblies from building structure to prevent transfer of loading imposed by structural movement.
 - 1. Provide isolation joints as indicated or required by installation quality standards.
 - 2. Isolate ceiling assemblies abutting or penetrated by building structure.
 - 3. Isolate partition framing and wall furring abutting or penetrated by building structure, except at floor.
- E. Supplemental Accessories: Install supplementary framing, blocking, reinforcing, and bracing in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, hand rails, furnishings, or similar construction. Comply with details indicated and recommendations of installation quality standards or manufacturer.

3.05 INSTALLING GYPSUM BOARD PRODUCTS

- A. General Requirements:
 - 1. Install type of gypsum board at location indicated by gypsum board schedule at end of this Section.
 - 2. Do not install damaged gypsum boards.
 - 3. Install gypsum boards with finishable face side out.
 - 4. Butt gypsum boards together for a light contact at edges and ends with not more than 1/16 in (1.5 mm) of open space between panels.
 - 5. Do not force gypsum boards into place.
 - 6. Do not place tapered edges against cut edges or ends.
- B. Isolation from Building Structure and Window and Door Frames:
 - 1. Apply edge trim where gypsum board abuts dissimilar materials.
 - 2. Provide 1/4 in to 1/2 in (6 mm in 12 mm) wide spaces at these locations and trim edges with edge trim where edges of gypsum boards are exposed.

- C. Single-Layer Board Assemblies:
 - 1. At typical conditions, install gypsum board vertically (long dimension parallel to metal framing), to minimize short end-to-short end joints unless otherwise indicated or required by assembly fire test reports.
- D. Ceiling Applications:
 - 1. Apply gypsum board at right angles to main beams of suspension framing to minimize number of abutting end joints and avoid abutting end joints in central area of each ceiling.
 - 2. Stagger abutting end joints of adjacent panels not less than one framing member.
 - 3. Locate both edge or end joints of gypsum boards over intermediate supports or gypsum board back-blocking where metal framing is not present.
- E. Screw Attachments:
 - 1. Attach gypsum board to metal framing with screw fasteners of type appropriate for gypsum board materials and installation conditions:
 - a. Length shall be as required by condition and penetrating metal framing not less than 3/8 in (10 mm).
 - b. Spacing shall be as recommended by installation quality standard, gypsum board manufacturer, or respective assembly test report.
 - c. Use properly adjusted, positive-clutch electric power tool equipped with adjustable screw-depth head and a Phillips bit. Nails and staples are not permitted.
 - 2. Drive screws to slightly dimple surface without breaking face paper, fracturing core, or stripping metal framing member around screw shank.
 - 3. Start field screwing near center and work towards edges.
 - 4. Space screws not less than 3/8 in (10 mm) from gypsum boards edges.
 - 5. Do not attach gypsum boards to top runner where wall or partition extends to building structure unless required by fire test reports.

3.06 INSTALLING TRIM ACCESSORIES

- A. Attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840.
 - 1. Install double studs to create control joints, leave 1/2 inch separation between gypsum board panels for installation of control joint units.
 - 3. Routing gypsum board to create joint is not acceptable.
- C. Control Joint Locations: Where indicated, but not less than the following.
 - 1. Locations of control and expansion joints in substrate or framing.
 - 2. Ceilings: In ceilings larger than 2500 square feet, locate control joints maximum 50 feet on center each way, and at all locations where framing or furring change direction. Coordinate locations with Architect.
 - 3. Joints between different types of gypsum board in same plane.
- D. Interior Trim:
 - 1. Cornerbead: Use at outside corners unless otherwise indicated.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. Curved-Edge Cornerbead: Use at curved openings.
- E. Exterior Trim:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
- F. Cornerbead: Install in single pieces at vertical corners.
- G. Edge Trim: Install where edge of gypsum board would otherwise be exposed or semi-exposed.
 - 1. Install trim in a single piece on each side of opening perimeters with joints only at corners. If size of opening exceeds available length of edge trim, coordinate locations of joints with Architect.

3.07 FINISHING GYPSUM BOARD PRODUCTS

- A. General: Treat board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare surfaces for decoration.
- B. Joint Tape: Finish joints according to following:
 - 1. Typical Paper-Faced Gypsum Board: Paper.
 - 2. Moisture-Resistant Paper-Faced Gypsum Board: Mesh tape.
- C. Finishing: Finish boards and units to achieve specified level of finish as indicated in schedule at end of section.
 - 1. Typical Paper-Faced Gypsum Board: Either or combination of the following as recommended by manufacturer:
 - a. Setting-type joint compounds.
 - b. Drying-type joint compounds.
 - 2. Moisture-Resistant Paper-Faced Gypsum Board: Setting-type joint compounds.

3.08 ADJUSTMENTS

- A. Damaged Materials: Stored or installed paper-faced gypsum board materials not specifically manufactured as "moisture-resistant products" shall be classified as damaged, defective, and nonconforming Work if they have been exposed to wetness or dampness at any time prior to Substantial Completion or if they exhibit evidence of active or dormant mold or mildew. Damaged materials and assemblies shall be replaced with new and dry materials and assemblies.

3.09 PROTECTION

- A. Procedures: Protect products and systems from damage during installation and remainder of construction period according to manufacturer's instructions.

3.10 GYPSUM BOARD FINISHING SCHEDULE

- A. Gypsum Board Finishing Schedule, General: Finish panels to Levels of Finish indicated below. Apply joint tape over panel joints, except those with trim having flanges not intended for tape. Sand between coats and after last coat to produce a surface free of defects and ready for applied finish system.
- B. Preparation: Apply joint compound at open joints, panel edges, and damaged surface areas.
- C. Level 4: At following locations, embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges:
 - 1. Areas to receive paint with eggshell/satin sheen or light texture.

END OF SECTION

SECTION 09 67 23
RESINOUS FLOORING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Resinous flooring systems and supplementary items for a complete installation.

1.02 ACTION SUBMITTALS

- A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- C. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.
- D. Product Schedule: For resinous flooring. Use same designations indicated on Drawings.

1.03 INFORMATIONAL SUBMITTAL

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- B. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- C. Qualification Data:
 - 1. For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
- D. Warranty: Sample of warranty.
 - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.
- E. Maintenance Data: To include in maintenance manuals. Submit manufacturer's instructions for maintenance of installed work, including methods and frequency for maintaining optimum condition under anticipated use. Include precautions against cleaning materials and methods which may be detrimental to finishes and performance. Include product data for flooring care products used or recommended by installer and names, addresses, and telephone numbers of local sources for products.

1.04 PERFORMANCE REQUIREMENTS

- A. Slip Resistance:
 - 1. Minimum coefficient of friction: ≥ 0.60 wet per ANSI/NFSI or ASTM D2047.
 - 2. Aggregate gradation and broadcast rate shall be selected to meet slip resistance in wet conditions.
- B. Antimicrobial:
 - 1. Resin binder shall contain an integrated antimicrobial additive to inhibit bacterial and fungal growth.
- C. Seamless & Hygienic:
 - 1. System shall be seamless, monolithic, with integral cove base where specified, and resistant to water intrusion.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with not less than 10 years' experience with successful production of products and systems similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 10 years, and with sufficient production capability, facilities, and personnel to produce required Work.
- B. Installer Qualifications:
 - 1. Manufacturer/Fabricator Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer/fabricator to install products.
 - 2. Experience: Installer with not less than 5 years' experience in performing specified Work similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 5 years, and with sufficient production capability, facilities, and personnel to produce required Work.
 - 3. Supervision: Installer shall maintain a competent supervisor who is at Project during times specified Work is in progress, and, who is experienced in installing systems similar to type and scope required for Project.
- C. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - a. Show typical components, attachments to building structure, and requirements of installation.
 - 2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
 - 3. Obtain Architect's acceptance of mock-ups before starting fabrication.
 - 4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor, submitted to Architect in writing, and accepted by Architect in writing.
 - 5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.06 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
 - 1. Participants:
 - a. Architect.
 - b. Contractor, including superintendent.
 - c. Installer, including project manager and supervisor.
 - d. If requested, Manufacturer/fabricator's qualified technical representative.
 - e. Installers of other construction interfaced with Work.
 - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
 - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
 - b. Review Work requirements (Drawings, Specifications, and other Contract Documents).
 - c. Review required submittals, both completed and yet to be completed.
 - d. Review required inspection and testing.
 - e. Review environmental conditions and procedures for coping with unfavorable conditions.
 - f. Resolve deviations or differences between Contract Documents and the manufacturer/fabricator's specifications.
 - 3. Contractor shall record discussions of conference.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

1.09 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1.10 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" are defined to include but not limited to deterioration or failure to perform as required.
 - 1. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 10 years from date of Contract Completion
- B. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
 - 1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Contract Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
 - 1. Dur-A-Flex, Inc, Dur-A-Quartz, Epoxy-Based seamless flooring system with antimicrobial additive.
- B. Available Manufacturers/Fabricators and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers/fabricators offering products that may be incorporated into the Work include, but are not limited to, those listed.
 - 1. Sherwin-Williams Resuflor Quartz with Bio-Pruf
 - 2. Stonhard Stontec QBF with antimicrobial
 - 3. Sika Sikafloor Quartzite

2.02 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

- B. VOC Content of Liquid-Applied Flooring Components: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

2.03 RESINOUS EPOXY FLOORING SYSTEM

- A. Resinous Flooring: A dense, liquid-rich, self-priming, textured, four component, polyurethane mortar system with a urethane-urea binder, pigments and graded quartz aggregates, abrasion and high temperature resistant monolithic floor surfacing designed to produce a seamless floor and integral cove base.
- B. Dur-A-Flex, Inc.; Dur-A-Quartz, Epoxy based seamless flooring system:
 - 1. System Materials:
 - a. Primer: Dur-A-Glaze #4 WB resin and hardener.
 - b. Broadcast Coats: Dur-A-Glaze #4 resin and hardener.
 - c. Quartz Aggregate: Q-28 colored quartz aggregate. Color selected by Architect from full color options.
 - d. Grout Coat: Dur-A-Glaze #4 resin and Water Clear hardener.
 - e. Topcoat: Armor Top resin, hardener and grit.
 - 2. Patch and Cove Materials:
 - a. Shallow Fill and Patching: Dur-A-Glaze #4 Cove-Rez.
 - b. Deep Fill and Sloping Material (over ¼ inch): Dur-A-Crete.
 - c. Cove, 4" without cove strip, Dur-A-Glaze hardener mixed with Cove Resin and quartz aggregate per mix.
 - 3. Moisture Mitigation System:
 - a. Dur-A-Glaze MVP Primer moisture mitigation system

2.04 INTEGRAL COVE BASE

- A. Provide and install an integral, seamless resinous cove base as part of the flooring system where indicated on drawings or required for hygiene and wash-down.
- B. Cove base shall be:
 - 1. Height: 6 inch standard.
 - 2. Radius: 1/2 inch internal radius.
 - 3. Integral and seamless with the floor system, formed using the same resin binder and colored quartz aggregate to match floor.
 - 4. Finished smooth and sealed with topcoat as per floor, maintaining continuous antimicrobial and chemical-resistant properties.
 - 5. Cove shall transition seamlessly into the floor with no ledges, gaps, or exposed substrate.

2.05 ACCESSORIES

- A. Primer: Type recommended by manufacturer for substrate and body coats indicated.
- B. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coats indicated and that prevents substrate cracks from reflecting through resinous flooring.
- C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract

Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.02 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer/fabricator's written installation instructions.
 2. Accepted submittals.
 3. Contract Documents.

3.03 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- C. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Mechanical surface preparation as follows:
 - a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.
 - b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
 - c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4 inch key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.
 - d. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.
 - e. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufacturer's recommendations.
 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab area in 24 hours.
 - b. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
 - c. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement.
 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
 5. Moisture Floor Treatment: For concrete substrates not meeting moisture test standards specified above, apply epoxy-based moisture floor treatment and cementitious overcoat to concrete substrate in accordance with manufacturer's written instructions.

- D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- E. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- F. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.04 APPLICATION

- A. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners. Extend integral cove base at top against metal cap strip.
 - 1. Integral Cove Base: 6 inches (150 mm) high.
- B. General:
 - 1. The system shall be applied in seven distinct steps as listed below:
 - a. Substrate preparation
 - b. Priming:
 - 1) An additional primer will include the Moisture Mitigation System if found to be required.
 - c. First broadcast coat application with first aggregate broadcast
 - d. Second broadcast coat with second aggregate broadcast
 - e. Grout coat application
 - f. First topcoat application
 - g. Second topcoat application
 - 2. Immediately prior to the application of any component of the system, the surface shall be dry, and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
 - 3. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
 - 4. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified.
 - 5. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.
- C. Primer:
 - 1. Coordinate exact primer requirements with manufacturers moisture mitigation system.
 - 2. The primer shall consist of a liquid resin and hardener that is mixed at the ratio of 1-part resin to 4 parts hardener per the manufacturer's instructions.
 - 3. The primer shall be applied by 1/8" notched squeegee and back rolled at the rate of 200 sf/gal to yield a dry film thickness of 4 mils.
- D. Broadcast Coat:
 - 1. The broadcast coat shall be applied as a double broadcast system.
 - 2. The broadcast coat shall be comprised of two components, a resin, and hardener as supplied by the Manufacturer and mixed in the ratio of 2 parts resin to 1-part hardener.
 - 3. The resin shall be added to the hardener and thoroughly mixed by suitably approved mechanical means.
 - 4. The broadcast coat shall be applied over horizontal surfaces using "v" notched squeegee and back rolled at the rate of 90-100 sf/gal.
 - 5. Colored quartz aggregate shall be broadcast to excess into the wet material at the rate of 0.5 lbs./sf.
 - 6. Allow material to fully cure. Vacuum, sweep and/or blow to remove loose aggregate.
 - 7. Apply a second coat of resin with a coverage rate of 90 sf/gal and broadcast aggregate to excess at the rate of 0.5 lbs./sf.
 - 8. Allow material to fully cure. Vacuum, sweep and/or blow to remove loose aggregate.

- E. Grout Coat:
 - 1. The grout coat shall be comprised of a liquid resin and a liquid hardener that is mixed in the ratio of 1-part hardener to 2 parts resin per the manufacturer's requirements.
- F. Topcoat:
 - 1. The topcoat shall be comprised of a liquid resin, hardener, and grit that is mixed per the manufacturer's requirements.
 - 2. The topcoat of Armor Top shall be roller applied at the rate of 500 sf/gal to yield a dry film thickness of 3 mils.
 - 3. The finish floor will have a nominal thickness of 1/8 inch. Surface texture as indicated per approved sample

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
- B. Owners Testing Agency Field Service: The Owner may employ and pay a qualified independent testing agency to perform field quality control. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractors expense.
 - 1. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - 2. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.
- C. Prepare test and inspection reports.

3.06 CLEANING AND PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.
- B. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes surface preparation and field painting and finishing of interior and exterior surfaces including:
 - 1. Scheduled and otherwise identified interior surfaces.
 - 2. Scheduled and identified exterior surface that are not to be treated with high-performance coatings.
 - 3. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified in other sections, and include sealers, primers, stains, fillers and other applied materials used as prime or intermediate coats.
- B. Interior items and surfaces not requiring painting, unless noted otherwise:
 - 1. Where specifically omitted.
 - 2. Items and surfaces permanently concealed in inaccessible areas such as above ceilings; including pipe, pipe covering, hangers, and conduit.
 - 3. Prefinished or naturally finished items such as exposed ornamental metalwork, sheet metal work, bronze, stainless steel, aluminum, and other prefinished materials.
 - 4. Labels, including code-required labels, equipment name, identification, performance rating or nomenclature plates.
 - 5. Operating parts.
 - 6. Surfaces where finishing is specified under other sections of the specifications.
 - 7. Items with factory applied finishes.
 - 8. Brick, stone, ceramic tile, plastic laminate.
 - 9. Moving parts of operating units.
 - 10. Acoustical ceilings.
- C. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically describe a particular item or a surface for a coating or color, paint the item or surface the same as similar adjacent equipment, materials or surfaces. If the schedules do not indicate color or finish, the A/E will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- D. Related Sections:
 - 1. Section 09 96 00 – High Performance Coatings

1.02 DEFINITIONS

- A. "Paint" as used herein means coating system materials including primers, emulsions, epoxy, enamels, sealers, fillers, and other applied materials whether used as prime, intermediate, or finish coats.
- B. Conform to PDCA Glossary for interpretation of terms used in this Section except as modified below.
 - 1. EXPOSED SURFACES: Surfaces of products, assemblies, and components visible from any angle after final installation. Includes internal surfaces visible when operable doors, panels or drawers are open, and surfaces visible behind registers, grilles, or louvers.
 - 2. CONCEALED SURFACES: Surfaces permanently hidden from view in finished construction and which are only visible after removal or disassembly of part or all of product or assembly.
 - 3. INACCESSIBLE SPACES: Spaces not intended for human use.
 - 4. Spaces listed below are defined as CONCEALED or INACCESSIBLE:
 - a. Space between suspended ceilings and floor or roof construction above.
 - b. Inside furred spaces.

- c. Inside of partitions
- d. Mechanical and electrical items enclosed within casework or equipment.
- e. Foundation spaces.
- f. Crawl spaces.
- g. Trenches and manholes.
- h. Mechanical shafts or chases.
- i. Enclosed elevator shafts (unless otherwise noted)
- j. Utility tunnels.

1.03 COLOR SCHEDULE

- A. Reference to a particular manufacturer's number or color name is used only as a convenience for the Architect in order to establish the Project color requirements. These references are not intended to describe the required generic paint systems. For generic paint systems requirements, refer to the "Schedule of Exterior Painting" and the "Schedule of Interior Painting" as applicable to the respective conditions of use.
- B. The selection of paint colors are indicated on the drawings by manufacturer and color type; designated as "P-__".
 - 1. Furnish the same lots, batches, etc. within the same contiguous areas of the building (i.e. corridors on the same floors, common rooms which adjoin each other, etc.).
- C. Color Schedule: The color schedule shall be considered as a guide only to color requirements; subject to Architect's modification or acceptance. For color schedule, refer to Finish Material Schedule on Drawings.
 - 1. Obtain schedule in advance of commencing work.
 - 2. Omissions in the color schedule shall not relieve the Contractor from performance in accordance with requirements of the Contract Documents.
 - 3. Obtain Architect's color, texture and sheen approval for painting unscheduled surfaces, if any.

1.04 ACTION SUBMITTALS

- A. Prepare submittals per requirements of Section 01 33 00 – Submittal Procedures.
- B. Product Data:
 - 1. Submit complete schedule of products proposed for use, by brand name and/or number including manufacturer's label analysis and description of products and their suitability for intended use for approval.
 - 2. Identify each material by manufacturer's catalog number, product name, and generic classification.
 - 3. Include typewritten list identifying paint systems and colors applied to each room, space, or item.
- C. Samples for Color and Sheen: Prepare one sample of each opaque finish paint specified in each color and sheen scheduled for appearance verification.
 - 1. Apply to 12 inch by 12 inch by ¼ inch hardboard. Apply sufficient paint thickness to provide proper hiding and appearance.
 - 2. Label each sample to indicate material, color, and sheen.
- D. Samples: Painting Systems:
 - 1. Prepare one sample of each opaque finish paint specified in each color and sheen scheduled for appearance verification.
 - 2. Submit samples on materials to which finishes will be applied, sample size. On one-half of the sample show the completed treatment, and on the other half show the successive steps taken in producing the finish.
 - a. Minimum sample size of 4 by 8 inches.
 - b. Step back each coat and process at least one inch to show bare substrate and each coat and process in system build-up.
 - c. Label each sample to indicate materials, color sheen, DFT or each coat applied, and total system DFT.
 - 3. Approved samples will be so marked; one set will be returned for the painter's use.
 - 4. Approved samples shall be standard of finish and color to be selected.

5. No finishes shall be applied on the work until samples are approved.

1.05 INFORMATIONAL SUBMITTALS

- A. Submit the following separate for other submittals:
 1. Certification specified in Quality Assurance article.
 2. Manufacturer's instructions.

1.06 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations; Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.07 FIELD SAMPLES

- A. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Duplicate finish of approved prepared samples.
 1. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
 - a. Wall Surfaces: Provide samples on at least 100 sq. ft. of wall surface.
 - b. Small Areas and Items: The Architect will designate an item or area as required.
 2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Paint and Coatings Schedules at the end of this section. Provide required sheen, color, and texture on each surface.
 - a. After finishes of mockups are accepted by the Architect, the Architect will use the approved mockup as the project standard for painting and coating work.
 3. Acceptance will be based on a final inspection of work by the Architect made at one time.
 4. Final approval of colors will be from job-applied samples.
 5. Execute all work under favorable conditions suitable for the production of good, durable work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in sealed containers, premixed and packaged by the manufacturer (or his authorized distributor), bearing the manufacturer's standard label showing trade name and number, label analysis, and directions for use.
 1. Label containers to indicate manufacturer's name, Product name and type of paint, brand code or stock number, date of manufacturer, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
 2. Do not open containers until contents are to be used.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F and maximum 90 degrees F. Maintain containers used in storage in a clean condition, free of foreign materials and residue, and with labels maintained in legible condition.
- C. Upon completion of work, leave storage area clean and in same condition as remainder of work.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Environmental Conditions: Comply with the more restrictive of the following or manufacturer's requirements under which systems can be applied.
 1. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures within specified limits and to exhaust hazardous fumes.
 2. Maintain temperature and humidity conditions for minimum 24 hours before, during, and 48 hours after application of finishes, unless longer times are required by manufacturer.

3. Do not permit wide variations in ambient temperatures which might result in condensation on freshly coated surfaces.
 4. Apply water-based paints only when surface temperature and surrounding air temperatures in each room are between 50 degrees F and 95 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.
 5. Apply solvent-thinned paints only when surface temperature and surrounding air temperatures in each room are between 45 degrees F and 95 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.
- B. Do not apply interior coatings under any of the following conditions:
1. When surface is not within the allowable moisture content as permitted by the paint manufacturer.
 2. When relative humidity is less than 20 percent or exceeds 85 percent.
 3. When temperature is less than 5 degrees F above dew point.
 4. When dust may be generated before paints have dried.
- C. Provide lighting level of 80 foot candles measured mid-height at substrate surface during application of paints.

1.10 COORDINATION

- A. Review other section specifying prime coats to ensure compatibility of the total paint system for various substrates.
1. Upon request from other trades, furnish information on characteristics for finish materials proposed for use to ensure compatibility of various parts.
 2. Test compatibility of existing coating, including shop applied primers and previously applied coating, by applying specified paint to small, inconspicuous area.
 3. If specified paint lifts or blisters existing coating, apply barrier or tie coat as recommended by paint manufacturer.
 4. If no compatible barrier or tie coat exists, remove existing coating completely and apply paint system as specified for new work.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Except for any special coatings specified or indicated elsewhere, provide painting products of one of the following manufacturers:
1. (Basis of Design) (BM) Benjamin Moore & Co., Montvale, NJ
 2. (SW) Sherwin-Williams Co., Cleveland, OH
 3. (PPG) PPG Paints, PPG Industries, Pittsburgh, PA

Note: Manufacturer designations in parenthesis are used in the Paint and Coatings schedule at the end of this section.

2.02 PAINT MATERIALS – GENERAL

- A. Provide manufacturer's 1st line professional quality paint/ coating materials for the coating systems specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- B. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- C. Provide related materials, such as linseed oil, shellac, turpentine, or other accessory materials of the highest quality approved for use by the manufacturer of the paint and used within paint manufacturers recommended limits.

2.03 ACCESSORY MATERIALS

- A. Muriatic Acid, Mildewcide, TSP (Tri-Sodium Phosphate), Acidic-Detergent, Zinc Sulfate, Sodium Metasilicate, And Solvent: Commercially available, non-damaging to surface being cleaned; as specified in PDCA Specification Manual; acceptable to paint manufacturer.
- B. Metal Conditioner: Proprietary phosphoric acid based, etching type solution; acceptable to paint manufacturer.
- C. Rust Inhibitor: Water containing 0.32 percent of sodium nitrite and 1.28 percent by weight of secondary ammonium phosphate (dibasic); or water containing 0.2 percent by weight of chromic acid or sodium chromate or sodium dichromate or potassium dichromate.
- D. Compounds: Spackling compound, putty, plastic wood filler, liquid de-glosser, latex patching plaster, latex base filler, thinners, and other materials not specifically indicated but required to achieve finishes specified. Pure, of highest commercial quality, compatible with paints and acceptable to paint manufacturer.
- E. Provide related materials, such as linseed oil, shellac, turpentine, or other accessory materials of the highest quality approved for use by the manufacturer of the paint and used within paint manufacturers recommended limits.

2.04 MIXING

- A. Use factory prepared colors matching approved samples. Site tinting is not permitted.
 - 1. Thoroughly mix and stir paints before use to ensure homogeneous dispersion of ingredients. Prior to application, blend multiple containers of same material and color by pouring from one container to another several times to ensure uniform consistency, color, and smoothness.
 - 2. Mix only in clean mixing pails of material recommended by manufacturer to avoid contamination.
 - 3. Remove film which may form on surface of material in containers and strain material before using. Stir frequently during use to maintain pigments in suspension. Do not stir film into material.
 - 4. Apply paints of consistency recommended by manufacturer. Thin only within recommended limits using thinners approved by paint manufacturer.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine substrates, areas, and conditions, with the applicator present, under which painting will be performed for compliance with paint application requirements.
 - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify the Architect of anticipated problems in application, system specifications, or possible incompatibility of coatings over substrates which are pre-primed or primed by others.
- C. Notify Architect a minimum of one working day prior to painting about possible problems resulting from using the specified materials over previously finished substrates.
- D. Conduct alkali testing with litmus paper on cementitious, and masonry surfaces, and do not begin painting if surfaces exceed alkalinity allowed by paint manufacturer.
- E. Test moisture content of surfaces using an electronic moisture meter. Do not begin application of coatings unless moisture content of exposed surfaces is below the following maximum values:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Masonry Surfaces: 12 percent.
 - 3. Finish Woodwork: 7 to 10 percent moisture content.
 - 4. Wood Surfaces: 15 percent.

5. Vertical Concrete Surfaces: 12 percent.
6. Horizontal Concrete Surfaces: 8 percent.

- F. Coordination of Work: Review other sections in which primers are specified to ensure compatibility for the total system with various substrates.

3.02 SURFACE-PREPARATION FOR NEW PAINTED SURFACES

- A. General: Use the cleaning methods specified in this article, using the gentlest appropriate method necessary to clean the surface.
- B. Wash surfaces by hand cleaning using clean rags, sponges, water, and detergent.
- C. Hand-Tool Cleaning: Use wet sanding and wet scraping methods only. Lightly mist substrate before sanding or scraping. Acceptable hand-tools include scrapers, wire brushes, sandpaper, steel wool, nonmetallic pads, and dusters. Because of varying substrates, selection of tools shall be the responsibility of Contractor. After hand-cleaning is attempted, power tool cleaning may be required to complete cleaning and surface preparation.
- D. Solvent Cleaning: Solvent cleaning may be used to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before preparation work begins. In addition, if necessary, spot-solvent cleaning may be employed just prior to the commencement of paint application, provided enough time is allowed for complete evaporation. Clean solvent and clean rags shall be used for the final wash to ensure that all foreign materials have been removed.
- E. General:
1. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 2. Protect elements surrounding the work of this section from damage or disfigurement. Provide drop cloths, shields, and protection methods to prevent spray or droppings from disfiguring other surfaces.
 3. Protect floors and adjacent work and materials. Remove and properly place temporary protection and coverings removed from the work area. Repair damage to other surfaces caused by work of this section.
 4. Remove empty paint containers from the site. Dispose in accordance with local disposal requirements.
- F. Clean and prepare substrate surfaces in accordance with manufacturer's instructions for each particular substrate condition. Remove oil and grease before mechanical cleaning. Clean and correct defects and deficiencies in substrate surfaces to be painted before applying paint or finish treatments.
1. Do not paint over dirt, rust, scale, grease, oil, moisture, or marred surfaces, mildewed surfaces or other conditions detrimental to formation of a durable paint film.
 2. Correct minor defects and clean surfaces which affect work of this Section.
 3. Seal marks which may bleed through surface finishes.
 4. Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach solution. Rinse with clean water and allow surface to dry thoroughly.
 5. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- G. Shop Primed Steel and Ferrous Metal Surfaces:
1. Bare Metal Solvent Cleaning: Clean with solvents to remove oil, grease, and other contaminants before other cleaning treatments are used. Do not use solvents, including primer thinner and turpentine, which leave residue.
 2. Shop Primed Steel Surfaces: Surfaces shall be clean and dry. Fill any open joints or deep abrasions in shop prime coat with filler, feather edges, sand smooth, and touch-up with metal primer compatible with shop primer, extending primer beyond treated area.
 3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces; remove rust, oil, grease, dirt, and other foreign substances. Use removal or cleaning methods that comply with paint manufacturer's written recommendations.

- a. Touch up bare areas and prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as shop coat.
 4. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents until surfaces are free of oil and surface contaminants.
 - a. Pretreat surfaces prior to application of prime coat with phosphate pretreatment. Strictly follow manufacturer's directions as to cleaning prior to treatment, application of treatment, and after-rinse.
 - b. Thoroughly clean all surfaces receiving directly applied prime coat with solvent or chemical washes, to remove oil, grease and other film. Wipe dry with clean cloths. Prime with zinc oxide primer.
 5. Conditioner (Apply to Bare Metal): Apply phosphoric acid-based, etching-type surface treatments after solvent cleaning and according to manufacturers' written instructions. Rinse with clear water when reaction is complete. Allow at least 15 to 30 minutes but not less time than recommended by manufacturer for metal conditioner to condition the metal surface. Do not allow conditioner to dry before rinsing. If white rust (zinc oxide) appears after drying, wash clean with denatured alcohol immediately before priming.
- H. Concrete Block Masonry Surfaces and Monolithic Concrete:
 1. Prepare surfaces by removing efflorescence, chalk, dust, dirt, grease, oils, and release agents dirt, dust, loose mortar, scale, salt or alkali powder, and oil or grease stains. Cracks, abrasions, and other defects shall be cut out, patched flush, and sanded smooth and sealed before applying prime coat.
 - a. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before applying paint.
 2. Cementitious Materials: Prepare concrete, concrete masonry block, surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
- I. Wood to Receive Painted Finish:
 1. Wood to be painted shall be back-primed on sides and edges. Use wood primer for back-priming, where opaque finish is specified.
 2. Sand to a smooth even surface and then dust off. Sand surfaces showing raised grain smooth between each coat.
 3. Wipe surface with a tack rag prior to applying finish.
 4. Surface painted with an opaque finish:
 - a. Coat knots, sap and pitch streaks with Knot Sealer before applying paint.
 - b. Apply two coats of Knot Sealer over large knots.
 5. After application of prime or first coat of stain, fill cracks, nail and screw holes, depressions and similar defects with wood filler paste. Sand the surface to make smooth and finish flush with adjacent surface.
 6. Before applying finish coat, reapply wood filler paste if required, and sand surface to remove surface blemishes. Finish flush with adjacent surfaces.
 7. Fill open grained wood such as oak, walnut, ash and mahogany with Wood Filler Paste, colored to match wood color.
 - a. Thin filler in accordance with manufacturer's instructions for application.
 - b. Remove excess filler, wipe as clean as possible, dry, and sand as specified.
- J. Gypsum Board:

1. New gypsum board must be clean and dry. All nail heads must be set and spackled. Joints must be taped and spackled and finished with joint compound. All dust must be removed prior to painting.
2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and wet sand; spot-prime with specified primer.

3.03 PROTECTION AND MASKING

- A. Take particular care to protect the following:
 1. Adjacent surfaces.
 2. Masonry surfaces.
 3. Metal surfaces.
 4. Wood surfaces.
- B. Protect areas retaining their original finishes from damage and overpaint.
- C. Protect the work of other trades against any overpainting, marring, masking residue, or other damage.
- D. Safeguard the building's lighting fixtures, floors, natural woodwork, masonry work, and equipment and materials to be installed.
- E. Mask, tape, and take great care when applying finish materials to areas adjacent to original finishes. Use products that will not damage surfaces or leave adhesive residue.
- F. Mask off with masking film and masking tape and/or cover with drop cloths all building elements and equipment not to be decorated prior to material application to ensure that over-spray or damage does not occur.
- G. If accessibility to surfaces is restricted, it is the paint contractor's responsibility to request that the obstructing materials be moved.
- H. All trades shall be responsible for making good any damage for which they are responsible. Correct damage by cleaning, repairing, or replacing, and repainting, as acceptable to the Architect.

3.04 APPLICATION

- A. Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied. Coat all surfaces specified, scheduled, illustrated, and otherwise exposed unless specifically noted otherwise.
 1. Apply paint of type, color, and sheen as scheduled.
 2. Number of coats specified is the minimum number acceptable.
 3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 4. Provide finish coats that are compatible with primers used.
 5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 6. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 7. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 8. Paint front and backsides of access panels and removable or hinged covers to match exposed surfaces unless these are scheduled to be pre-finished items.
 9. Finish doors on tops, bottoms, and side edges the same as face surfaces.
 10. Finish edges of paints adjoining other materials or colors sharp and clean, without overlapping.
 11. Provide specified primer and finish coats on all surfaces of window frames and stops. Concealed ends and edges of window sashes are to receive primer and first coat of finish.
 12. Sand lightly between each succeeding enamel or varnish coat.
 13. Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.

14. Prime all surfaces to receive vinyl, fabric, paper wall and other types of wall coverings, unless otherwise indicated.
 15. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the room treatment schedule or the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate a paint coating system for a particular substrate, defer to the Architect for selection of finish system and color.
1. Items such as doors and door frames that are exposed on two faces and which occur between two rooms or spaces are to be finished/ painted on both sides unless otherwise noted.
 2. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, supports, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
 3. At any surface which is not scheduled to be painted, but which has been affected by cutting and patching or selective demolition, paint the surface with the pertinent coating system for the substrate type as scheduled in this section to the extent of the surface area. At walls, to inside or outside corners of the affected area; at ceilings to the extent of the ceiling area in each space.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels, unless otherwise specifically indicated to be painted.
1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork and casework.
 - b. Acoustical wall panels.
 - c. Metal toilet enclosures.
 - d. Metal lockers.
 - e. Elevator entrance doors and frames.
 - f. Elevator equipment.
 - g. Finished mechanical and electrical equipment.
 - h. Light fixtures.
 - i. Distribution cabinets.
 2. Finished metal surfaces include the following:
 - a. Anodized aluminum
 - b. Stainless steel
 - c. Chromium plate
 - d. Copper
 - e. Bronze and brass
- D. Scheduling Painting: Apply prime coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to maintain a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. 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.
 3. Omit primer on metal surfaces that have been shop primed and touchup painted with compatible materials.
 4. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 5. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

- E. Application: Apply paint in accordance with the manufacturer's directions. Use techniques best suited for substrate and type of material being applied. Apply using airless spray to greatest extent possible for doors and door frames and other medium to high gloss paints. Brushes and rollers shall be of a type best suited for the type of material being applied.
 - 1. Apply intermediate and finish coats within the manufacturer's recommended top coating time periods.
 - 2. When applying paint to drywall, use a roller nap no greater than 3/8 inch so as to achieve a light stipple finish.
 - 3. If metal doors, and plaster surfaces are not sprayed, finish may be applied with 1/4 inch nap roller. Brush and level out paint applied to metal door frames to achieve a nearly sprayed-on appearance.
- F. Apply paint systems to total dry film thickness in manufacturers specifications. Apply material at not less than manufacturer's recommended spreading rate. Do not exceed maximum single coat thickness recommendation by paint manufacturer. Do not double-back with spray equipment by building up film thickness of two coats in one pass. Ensure that edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent of flat surfaces.
- G. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- H. Prime Coats: Before applying finish coats, roll a prime coat of material, as recommended by the manufacturer as follows:
 - 1. Apply a prime coat to material which is required to be painted or finished and which has not been prime coated by others.
 - 2. Re-coat primed and sealed walls and ceilings 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.
 - 3. Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks or other surface imperfections.
- I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- J. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
 - 1. Provide satin finish for final coats.
- K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.05 CLEANING AND PROTECTION

- A. Cleaning: Comply with Section 01 77 19 – Closeout Requirements. Promptly remove spilled, splashed, or spattered paints. Clean spots, oil, and other soiling from finished surfaces using cleaning agents and methods which will not damage materials.
 - 1. If completed construction is damaged beyond normal cleaning or repair by painting operations, replace damaged items at no additional cost to Owner.
 - 2. Maintain premises and storage areas free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
 - 3. Collect waste, cloths, and material which may constitute fire hazards and place in closed metal containers; remove from site daily along with empty containers.
- B. Protection: Protect finished work in accordance with Section 01 50 00 – Temporary Facilities and Controls.
 - 1. Protect work of other trades against damage from paint activities. Correct damage by cleaning, repairing, replacing, and repaint as acceptable to Architect.
 - 2. Provide "Wet Paint" signs and other methods to protect newly coated surfaces. Remove when directed or when no longer needed.

3.06 EXTERIOR PAINT AND COATINGS SCHEDULE

- A. Exterior Wood Surfaces for Opaque Finish:
 - 1 coat SW Exterior Latex Wood Primer, B42W8041
 - 1 coat SW A-100 Exterior Latex

 - 1 coat BM Fresh Start Acrylic Primer (023)
 - 2 coats BM AURA Waterborne Exterior Paint

 - 1 coat PPG Paints 72-1 SunProof Exterior Acrylic Wood Primer
 - 2 coats PPG Paints 78-45 Sun-Proof Acrylic House & Trim Paint

- B. Galvanized Metal: Hollow metal doors and frames, exposed to weather steel lintels:
 - 1. Surface Prep: Solvent Cleaning SSPC-SP1
 - a. Prime:
 - 1) Zinc Clad IV
 - b. Intermediate:
 - 1) Macropoxy 646 Fast Cure Epoxy (5.0 – 10.0 mils dry)
 - c. Finish Coats (2 coats):
 - 1) Pro Industrial Waterbased Acrolon 100 Polyurethane Semi-Gloss (1.4 mils dry per coat)

3.07 INTERIOR PAINT AND COATINGS SCHEDULE

- A. Schedule: Provide products and number of coats specified. Use of manufacturer's proprietary product names to designate colors, materials, generic class, standard of quality and performance criteria and is not intended to imply that products named are required to be used to the exclusion of equivalent performing products of other manufacturers.

- B. Shop Primed Metal: Interior Structural Steel, Hollow Metal Doors, Frames, and other Ferrous Metal Surfaces for semi-gloss finish: Lining of Mechanical Equipment, Convactor Cabinets, Unit Ventilators or Ducts Visible Through Grilles or Louvers:
 - 1. First Coat: Primer
(NOTE: Primer also required on galvanized surfaces. All shop primed surfaces shall be reprimed with proper primer per manufacturer's instructions prior to applying coatings scheduled herein).
 - 2. Interior Latex Enamel: Factory-formulated latex enamel for interior applications:
 - a. 1 coat S-W; ProCryl Universal Metal Primer B66W310 Applied at a dry film thickness of not less than 3.0 mils
2 coats S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series at 2.5 to 4.0 mils dry, per coat.
 - b. 1 coat: BM Super Spec® HP Alkyd Metal Primer P06 (323 g/L)
2 coats: BM Advance Waterborne Interior Alkyd Semi-Gloss 793 (48 g/L)
 - c. 1 coat: PPG; Speedhide Rust-Inhibitive Steel Primer, 6-208 Series; applied at 1.5 mils minimum DFT
2 coats: PPG; Speedhide Zero Interior Latex Semi-Gloss, 6-5510 Series; applied at 1.5 mils minimum DFT.

- C. Interior Wood Trim for Opaque Finish: (Acrylic-Enamel and Semigloss Alkyd-Enamel Finishes: Factory-formulated alkyd- or acrylic-latex based interior wood primer)
 - 1. Semi-Gloss Finish: Two finish coats over a wood undercoater.
 - a. 1 Coat: S-W PrepRite ProBlock Latex B51 Series: Applied at a dry film thickness of not less than 1.4 mils (4 mils wet).
2 Coats: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series: Applied at a dry film thickness of not less than 1.7 mils per coat (4 mils wet).

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- b. 1 Coat –BM Fresh Start Multi-Purpose Primer (023)
2 coats: BM Advance Waterborne Alkyd Finish Satin (792), Semi-Gloss (793), High Gloss (794)
 - c. 1 coat: PPG SEAL GRIP® Interior/Exterior Acrylic Universal Primer/Sealer 17-921XI
2 coats PPG: SPEEDHIDE® Interior Enamel Latex Semi-Gloss 6-500
- D. Gypsum Board Wall Surfaces: (Eggshell sheen)
 - 1. 1 Coat: S-W ProMar 200 Interior Latex Wall Primer, B28W8200, (4 mils wet, 1.3 mils dry per coat).
2 Coats: S-W ProMar 200 Acrylic Latex Egg-Shell Enamel B20W200, (4 mils wet, 1.6 mils dry per coat)
 - 2. 1 coat BM Ultra Spec 500 Interior Latex Primer N534 (0 g/L)
2 coats: BM; Ultra Spec 500 Latex Eggshell N538 (0 g/L)
 - 3. 1 coat PPG: "Speedhide zero Interior Zero VOC Latex Sealer 6-4900XI." (0 g/L)
2 coats PPG: "Speedhide zero Interior Zero VOC Latex Eggshell 6-4310XI Series." (0 g/L)
- E. Gypsum Board Ceilings: (Flat Sheen)
 - 1. 1 coat: S-W ProMar 200 Interior Latex Wall Primer, B28W8200, (4 mils wet, 1.3 mils dry per coat)
2 coats: S-W ProMar 200 Interior Latex Flat Wall Paint, B30 Series, (4 mils wet, 1.6 mils dry per coat)
 - 2. 1 coat Benjamin Moore; Ultra Spec 500 Interior Latex Primer N534 (0 g/L)
2 coats: Benjamin Moore; Ultra Spec 500 Interior Latex Flat N536 (0 g/L)
 - 3. 1 coat PPG: "Speedhide zero Interior Zero VOC Latex Sealer 6-4900XI." (0 g/L)
2 coats PPG: "Speedhide zero Interior Zero VOC Latex Flat 6-4110XI." (0 g/L)
- F. Concrete Masonry Surfaces:
 - 1. 1 coat SW PrepRite Interior/Exterior Latex Block Filler B25W00025
2 coats S-W: ProMar 200 Zero VOC Interior Latex Eg-Shel Enamel B20W12651 Series.
 - 2. 1 coat BM Moorcraft Interior and Exterior Block Filler #173
2 coats BM Moore's Regal Aqua Velvet #319
 - 3. 1 coat PPG Paints : "Speedhide Interior/Exterior Masonry Hi-Fill Block Filler 6-15XI." (50 g/L)
2 coats PPG Paints : "Speedhide zero Interior Zero VOC Latex Semi-Gloss 6-4310XI Series." (0 g/L)
- G. Ferrous and Galvanized Metal at Exposed Ceiling Construction including Ductwork, Conduits, and Piping (Not less than 10 feet AFF):

Notes: Verify color with Architect.
Primer not required for previously painted surfaces.

 - 1. 1 Coat: S-W Pro Industrial Pro-Cryl Universal Metal Primer: Applied at a dry film thickness of not less than 2.5 to 4 mils.
2 Coats: S-W Pro Industrial Waterborne Acrylic DryFall Semi-Gloss, B42-83
 - 2. 1 coat: BM: Super Spec® HP Acrylic Metal Primer P04
2 coats: BM: Dry Fall Latex Semi-Gloss 397 (43 g/L) applied at 1.4 mils minimum DFT
 - 3. 1 Coat: PPG PPG Paints; Multi-prime Multi-Purpose Primer, 4160 Series; applied at 2.0 mils minimum DFT
2 Coats: PPG Speedhide Super Tech WB Interior 100% Acrylic Latex Dry Fog, Semi-Gloss 6-727XI Series; applied at 2.2 mils minimum DFT.
- H. Lining of Mechanical Equipment, Convactor Cabinets, Unit Ventilators or Ducts Visible Through Grilles or Louvers:
 - 1. 2 coats SW Industrial Enamel HS, B54WZ0401 Series.
 - 2. 2 coats BM Satin Impervo Enamel (235).
 - 3. 2 coats PPG Paints Speedhide 6-753, Flat Black Latex Paint
- I. Exposed Insulated Piping, Ductwork, Vessels:
 - 1. 1 coat Sherwin-Williams; PrepRite Masonry Primer B28W00300: Applied at a dry film thickness of not less than 3.0 mils
2 coats SW (Finish same as adjoining walls or ceiling)

2. 1 coat Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
2 coats BM (Finish same as adjoining walls or ceiling)
3. 2 coats PPG Paints ("Finish same as adjoining walls or ceiling")

J. Exposed Uninsulated Piping:

1. 1 coat S-W Kem Bond® HS High Solids Alkyd Universal Metal Primer , B50AZ0008 Series apply at a dry film thickness of not less than 3.0 mils
2 coats S-W (Finish same as adjoining walls or ceiling)
2. 1 coat BM; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils
2 coats BM (Finish same as adjoining walls or ceiling).
3. 1 coat PPG Paints Multiprime 4360 Low VOC Alkyd Corrosion Resistant Primer. Applied at a dry film thickness of not less than 2.0 mils.
2 coats PPG Paints ("Finish same as adjoining walls or ceiling")

END OF SECTION

SECTION 09 96 00
HIGH PERFORMANCE COATINGS
FOR ARCHITECTUALLY EXPOSED STRUCTURAL STEEL (AESS)

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. This section includes shop and field surface preparation and painting of scheduled substrates.
 - 1. Surface preparation, including in the shop applications of metal primer; and field application of primers and finishes are specified in this Section.
 - 2. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:
 - 1. Exterior Substrates:
 - a. Ferrous Metals
 - b. Non-Ferrous Metals
- B. Related Sections include the following:
 - 1. Division 05 Metals:
 - a. Note: This section supersedes all references within Division 05 sections referencing the selection and/or application of shop-applied primer to steel substrates.

1.03 REFERENCES

- A. This Section contains references to the governing standards and documents listed below. They are a part of this Section as specified and modified; the current version shall apply unless otherwise noted. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.
- B. ASTM International (ASTM):
 - 1. ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
- C. SSPC: The Society of Protective Coatings (SSPC):
 - 1. SSPC-SP 1 – Solvent Cleaning.
 - 2. SSPC-SP 2 – Hand Tool Cleaning.
 - 3. SSPC-SP 3 – Power Tool Cleaning.
 - 4. SSPC-SP 6 – Commercial Blast Cleaning.
 - 5. SSPC-SP 11 – Power Tool Cleaning to Bare Metal.
 - 6. SSPC-SP 16 – Brush-Off Blast Cleaning Non-Ferrous Metals.
 - 7. SSPC-PA 2 – Measurement of Dry Coating with Magnetic Gauges.
- D. Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents, the last version of the document before it was discontinued.

1.04 ACTION SUBMITTALS

- A. Submit the following under provisions of Section 01 33 00 – Submittal Procedures.
- B. Submit for approval prior to commencing any work:
 - 1. Manufacturers data sheets on each product to be used, including:

- a. Preparation instructions and recommendations.
 - b. Storage and handling requirements and recommendations.
 - c. Installation methods.
 - d. Operation and maintenance data.
 - e. Submit manufacturer's Safety Data Sheets (SDS) and other safety requirements.
- C. Shop Drawings:
 - 1. Submit a complete list of products proposed for use, including identifying product names and catalog numbers.
 - a. Arrange in same format as Schedule of Finishes.
 - b. Include applicable manufacturer's data and recommendations.
- D. Selection Samples: For each finish product specified, provide two complete sets of color chips representing manufacturer's full range of available colors.
- E. Verification Samples: For each finish product specified, provide two samples, minimum size 3 x 4 inch square, representing actual product, color and patterns.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Provide products from a company specializing in manufacture of high-performance epoxy coatings with a minimum of ten (10) years' experience.
 - 1. Materials shall be products of a single manufacturer or items standard with manufacture of specified coating materials.
 - 2. Submit manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.
- B. Applicator's Qualifications: Engage a single installer approved by the manufacturer with a minimum of three (3) years' experience in the application of protective coatings with documented skill and successful experience in the installation.
 - 1. Submit name and qualifications to Architect.
 - 2. Submit proof of acceptability of applicator by manufacturer to Architect.
- C. Single-Source Responsibility:
 - 1. Materials shall be products of a single manufacturer or items standard with manufacturer of specified coating materials.
 - 2. Provide secondary materials which are produced or are specifically recommended by coating system manufacturer to ensure compatibility of system.
- D. Regulatory Requirements: Conform to applicable codes and ordinances for flame, fuel, smoke and volatile organic compounds (VOC) ratings requirements for finishes at time of application.
- E. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Prepare a ten (10) foot by ten (10) foot mock-up for each coating system specified using same materials, tools, equipment, and procedures intended for actual surface preparation and application.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.
 - 4. Retain mock-ups to establish intended standards by which coating systems will be judged.
- F. Pre-Installation Meeting:
 - 1. Schedule a conference and inspection to be held on-site before field application of coating systems begins.
 - 2. Conference shall be attended by Contractor, Owner's representative, Architect, coating applicators, and a representative of coating material manufacturer.
 - 3. Topics to be discussed at meeting shall include:
 - a. A review of Contract Documents and accepted shop drawings shall be made and deviations or differences shall be resolved.

- b. Review items such as environmental conditions, surface conditions, surface preparation, application procedures, and protection following application. A surface mock-up of the surface preparation requirements for the project, both interior and exterior, shall be prepared by the Contractor. All parties shall agree to the degree of cleanliness and the mock-up shall be preserved for the duration of the project.
 - c. Establish which areas on-site will be available for use as storage areas and working area.
- 4. Pre-construction conference and inspection shall serve to clarify Contract Documents, application requirements and what work should be completed before coating application can begin.
- 5. Prepare and submit, to parties in attendance, a written report of pre-installation conference. Report shall be submitted within 3 days following conference.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: All coatings shall be properly prepared by the manufacturer and delivered to the site for field painting in the original, unbroken containers with manufacturer's label plainly printed thereon clearly identifying:
 - 1. Coating or material name.
 - 2. Manufacturer.
 - 3. Color name and number.
 - 4. Batch or lot number.
 - 5. Date of manufacture.
 - 6. Mixing and thinning instructions.
- B. Storage:
 - 1. Store materials in a clean, dry area and within temperature range in accordance with manufacturer's instructions.
 - 2. Keep containers sealed until ready for use.
 - 3. Flammable coatings must be stored to conform to City, County, State and Federal safety codes for flammable coatings or paint materials.
 - 4. At all times, coatings shall be protected from freezing.
 - 5. Do not use materials beyond manufacturer's shelf life limits.
- C. Handling: Protect materials during handling and application to prevent damage or contamination.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 PROJECT CONDITIONS

- A. 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.
- B. Weather:
 - 1. Air and surface temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.
 - 2. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above the dew point.
 - 3. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
 - 4. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
 - 5. Wind: Do not spray coatings if wind velocity is above manufacturer's recommended limit.
- C. Ventilation: Provide ventilation during coating application and curing in confined or enclosed areas in accordance with industry standard health and safety practices.
- D. Dust and Contaminants:
 - 1. Schedule coating work to avoid excessive dust and airborne contaminants.
 - 2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

1.08 WARRANTIES

- A. Architecturally Exposed Structural Steel (AESS) Systems
 - 1. Coating systems shall be installed as required to qualify for manufacturer's standard fifteen (15) year warranty against corrosion, crack, check, peel, color shift, loss of gloss and chalking.
 - 2. Warranted product's documented commercial availability in the marketplace shall not be a shorter duration than the specified warranty term.
 - 3. Warranty coverage shall be expressed in the following terms:
 - a. Corrosion (Ferrous Metals with Zinc Primer Only): Allowable % of corroded surface area as measured per ASTM D 610-95 for first five years and each year thereafter.
 - b. Fade (Color Change): DE_{Hunter} Units per ASTM D 2244.
 - c. Gloss: Units as measured by a gloss meter referencing ASTM D 523-89 with 60-degree geometry.
 - d. Chalk: Rating as per ASTM D 4214, Method A.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Basis of Design (Standard of Quality):
 - 1. Tnemec Company, Incorporated
800.890.7580, www.tnemec.com
- B. Product Distribution and Technical Representation:
 - 1. Redox Coating Consultants, LLC
614.850.8160, www.redoxcoatings.com, redox@redoxcoatings.com
- C. Materials specified herein shall not preclude consideration of equivalent or superior materials. Suggested equivalent materials or other substitutions shall be submitted to SPECIFIER for consideration in compliance with substitution procedures in Section 01 25 00 of this Project Manual and include the following:
 - 1. Evidence of satisfactory past performance in similar environment.
 - 2. Complete side-by-side coating system comparisons which provide, at minimum:
 - a. Direct correlation of the submitted products to the specified products, organized and outlined to coincide with, and reference directly to, the Coating Schedule as listed in this specification.
 - b. All required performance criteria testing data referencing the specified testing protocols for each product. Complete test results must be submitted. "Pass/Fail" results shall not be accepted.
 - c. Draft warranties for submitted systems expressed in the required terms as applicable per "Warranties" article of this Specification Section.
- D. Substitution submittals shall be provided no later than (10) days prior to the date set for receipt of bids.
- E. Substitutions will not be considered that change the generic chemistry of the system components, reduce the number of coats, or do not meet specified dry film thicknesses.
- F. Bidders desiring to use coatings other than those specified shall submit their proposal based on the basis-of-design coatings systems along with a substitution request submittal which includes all information required in Paragraph 2.1.C above and indicate the sum which will be deducted from the base bid should the proposed alternate materials be accepted.

2.02 HIGH PERFORMANCE COATINGS GENERAL

- A. Compatibility: Provide shop and field primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.03 MATERIALS

- A. Primer, Ferrous Metals (Bare Metal)
 - 1. Tnemec Series 94-H2O Hydro-Zinc
 - 2. Formulation Description: Single Component, Zinc Rich Moisture Cured Urethane
 - 3. Performance Criteria:
 - a. Adhesion: ASTM D 4541 (Method B, Type II Tester) – Minimum 1,500 psi
 - b. Adhesion: ASTM D 4541 (Method E, Type V Tester) – Minimum 1,730 psi
 - c. Cathodic Disbondment: ASTM G 8 (Method A) – No blistering, cracking, rusting, or delamination and no undercutting at holiday after 30 days exposure.
 - d. Corrosion Protection of Steel Structures: ISO 12944-6 – C5 High Durability
 - e. Prohesion: ASTM G 85 – Minimum 10,000 Hours
 - f. Salt Spray (Fog): ASTM B 117 – Minimum 10,000 Hours
- B. Stripe & Intermediate Coats, Ferrous & Non-Ferrous Metals
 - 1. Product: Tnemec Series V69 Hi-Build Epoxoline II
 - 2. Generic Chemistry: Polyamidoamine Epoxy
 - 3. Performance Criteria:
 - a. Adhesion: ASTM D 4541 (Method B, Type II Tester) – Minimum 1,650 psi
 - b. Adhesion: ASTM D 4541 (Method E, Type V Tester) – Minimum 1,900 psi
 - c. Humidity: ASTM D 4585 – Minimum 4,500 Hours
 - d. Prohesion: ASTM G 85 – Minimum 5,000 Hours
 - e. Salt Spray (Fog): ASTM B 117 – Minimum 10,000 Hours
- C. Intermediate Coat, Exterior Ferrous Metals
 - 1. Tnemec Series 1095 Endura-Shield
 - 2. Formulation Description: Aliphatic Acrylic Polyurethane
 - 3. Performance Criteria:
 - a. Adhesion: ASTM D 4541 (Method E, Type V Tester) – Minimum 1,400 psi
 - b. Corrosion Protection of Steel Structures: ISO 12944-6 – C4 High Durability
 - c. Cyclic Salt Fog/UV Exposure: ASTM D 5894 – Minimum 5,000 Hours
 - d. Humidity: ASTM D 4585 – Minimum 5,000 Hours
 - e. Prohesion: ASTM G 85 – Minimum 5,000 Hours
 - f. QUV Exposure: ASTM D 4587 – Minimum 4,000 Hours
 - g. Salt Spray (Fog): ASTM B 117 – Minimum 5,000 Hours
- D. Finish Coat, Ferrous Metals
 - 1. Tnemec Series 1070V Fluoronar
 - 2. Formulation Description: Advanced Thermoset Solution Fluoropolymer
 - 3. Performance Criteria:
 - a. Adhesion: ASTM D 4541 (Method B, Type II Tester) – Minimum 1,300 psi
 - b. Adhesion: ASTM D 4541 (Method E, Type V Tester) – Minimum 1,900 psi
 - c. Carbon Arc Weathering: ASTM G 153 – Minimum 5,500 Hours
 - d. Cleanability: MIL-PRF-85285D Section 4.6.13 – Minimum 95% Efficiency
 - e. Exterior Exposure: ASTM D 1014 (AAMA 2605) – Must Exceed Weathering Requirements
 - f. Exterior Exposure: ASTM D 4141 (Method C, EMMAQUA) – Minimum 5,000 MJ/m² (166,000 MJ/m² total minimum).
 - g. Humidity: ASTM D 4585 – Minimum 3,000 Hours
 - h. QUV Exposure: ASTM D 4587 (UVA 340 Bulbs, Cycle 4: 8 Hours UV/4 Hour Condensation) – Minimum 25,000 Hours
 - i. Salt Spray (Fog): ASTM B 117 – Minimum 10,000 Hours
 - j. Xenon Arc Weathering: ASTM D 6695 – Minimum 8,000 Hours
- E. Finish Coat, Ferrous Metals (Pedestrian Traffic Bearing Surfaces)
 - 1. Tnemec Series V290 CRU
 - 2. Formulation Description: Aliphatic Polyester Polyurethane
 - 3. Performance Criteria:

- a. Abrasion: ASTM D 4060 (CS-17 Wheel, 1,000 gram load) – Maximum 30 mg loss, 1,000 Cycles
- b. Coefficient of Friction: ASTM D 2047 – Minimum 0.67, without additives
- c. Impact: ASTM D 2794 – Minimum 160 inch/pounds, direct
- d. QUV Exposure: ASTM D 4587 (UVA 340 Bulbs, Cycle 4: 8 Hours UV/4 Hour Condensation) – Minimum 2,000 Hours

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.

3.02 PROTECTION

- A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.
- B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

3.03 SURFACE PREPARATION OF FERROUS METAL

- A. Prepare ferrous metal surfaces in accordance with manufacturer's instructions.
- B. Fabrication Defects:
 - 1. Correct steel and fabrication defects revealed by surface preparation.
 - 2. Remove weld spatter and slag.
 - 3. Round sharp edges and corners of welds to a smooth contour.
 - 4. Smooth weld undercuts and recesses.
 - 5. Grind down porous welds to pinhole-free metal.
 - 6. Remove weld flux from surface.
- C. Ensure surfaces are dry.
- D. Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3), unless otherwise specified.
- E. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.

3.04 APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions.
- B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
- C. Keep containers closed when not in use to avoid contamination.
- D. Do not use mixed coatings beyond pot life limits.
- E. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.
- F. Uniformly apply coatings at spreading rate required to achieve specified DFT.
- G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
- H. Stripe paint with brush critical locations on steel, such as welds, corners, and edges using specified primer.

3.05 REPAIR

- A. Materials and Surfaces Not Scheduled to be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.

- B. Damaged Coatings: Touch-up or repair of damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.
- C. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.06 FIELD QUALITY CONTROL

- A. Inspector's Services:
 - 1. Verify coatings and other materials are as specified.
 - 2. Verify surface preparation and application is as specified.
 - 3. Verify DFT of each coat and total DFT of each coating system specified using wet film and dry film gauges.
 - 4. Coating Defects: Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
 - 5. Report:
 - a. Submit written reports describing inspections made and actions taken to correct non-conforming work.
 - b. Report non-conforming work not corrected.
 - c. Submit copies of report to Architect and Contractor.
- B. Manufacturer's Technical Services: Coordinate with coating manufacturer's technical service department or independent sales representative for current technical data and instructions and onsite consultation as needed.
- C. One-Year Inspection:
 - 1. Owner will set date for one-year inspection of coating systems.
 - 2. Inspection shall be attended by Owner, Contractor, Architect, and manufacturer's representative.
 - 3. Repair deficiencies in coating systems as determined by Architect in accordance with manufacturer's instructions.

3.07 CLEANING

- A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.08 PROTECTION OF COATING SYSTEMS

- A. Protect surfaces of coating systems from damage during construction.
- B. Touch-up, or repair damaged products before substantial completion.

3.09 COATING SYSTEM SCHEDULE:

- A. Exterior Ferrous & Non-Ferrous Metals (AESS Fluoropolymer Finish – 15 Year Warranty)
 - 1. Shop Surface Preparation:
 - a. Steel:
 - 1) Abrasive blast referencing SSPC-SP 6 Commercial Blast Cleaning to provide a minimum angular surface profile of 1.0 mil.
 - b. Galvanized:
 - 1) Visible deposits of oil, grease, or other contaminants shall be removed as required by SSPC-SP1 using Great Lakes Laboratories Clean'N'Etch, or similar. Check for presence of passivating agents using copper sulfate solution. Repeat SSPC-SP 1 until all passivating agents have been completely removed.
 - 2) Sweep (Abrasive) Blasting per SSPC-SP16 to achieve a uniform anchor profile (1.0 to 2.0 mils).
 - c. Prepared substrates must be clean, dry, and free of contaminants.
 - 2. Shop-Applied Primer:

- a. Steel: Tnemec Series 94-H2O Hydro-Zinc applied at 2.5 to 3.5 mils DFT
 - b. Galvanized: Tnemec Series V69 Hi-Build Epoxoline II applied at 3.0 to 5.0 mils DFT
 - 3. Stripe Coat (Shop or Field): Tnemec Series V69 Hi-Build Epoxoline II applied at all corners, protrusions, welded and bolted connections, etc.
 - 4. 1st Intermediate (Shop or Field): Tnemec Series V69 Hi-Build Epoxoline II applied at 4.0 to 6.0 mils DFT
 - 5. 2nd Intermediate (Shop or Field): Tnemec Series 1095 Endura-Shield applied at 2.0 to 3.0 mils DFT
 - 6. Field-Applied Finish: Tnemec Series 1070V Fluoronar applied at 2.0 to 3.0 mils DFT
 - 7. Warranty: Manufacturer's standard fifteen-year guarantee against corrosion, color fade, loss of gloss, and chalking.
- B. Exterior Ferrous & Non-Ferrous Metals (Pedestrian Traffic Bearing Surfaces)
- 1. Shop Surface Preparation:
 - a. Steel:
 - 1) Abrasive blast referencing SSPC-SP 6 Commercial Blast Cleaning to provide a minimum angular surface profile of 1.0 mil.
 - b. Galvanized:
 - 1) Visible deposits of oil, grease, or other contaminants shall be removed as required by SSPC-SP1 using Great Lakes Laboratories Clean'N'Etch, or similar. Check for presence of passivating agents using copper sulfate solution. Repeat SSPC-SP 1 until all passivating agents have been completely removed.
 - 2) Sweep (Abrasive) Blasting per SSPC-SP16 to achieve a uniform anchor profile (1.0 to 2.0 mils).
 - c. Prepared substrates must be clean, dry, and free of contaminants.
 - 2. Shop-Applied Primer:
 - a. Steel: Tnemec Series 94-H2O Hydro-Zinc applied at 2.5 to 3.5 mils DFT
 - b. Galvanized: Tnemec Series V69 Hi-Build Epoxoline II applied at 3.0 to 5.0 mils DFT
 - 3. Stripe Coat (Shop or Field): Tnemec Series V69 Hi-Build Epoxoline II applied at all corners, protrusions, welded and bolted connections, etc.
 - 4. Intermediate (Shop or Field): Tnemec Series V69 Hi-Build Epoxoline II applied at 4.0 to 6.0 mils DFT
 - 5. Finish: Tnemec Series V290 CRU applied at 2.0 to 3.0 mils DFT with Series 211-0212 Glass Bead additive.
 - 6. Warranty: Standard manufacturer's guarantee

END OF SECTION

SECTION 09 61 16
CONCRETE FLOOR SEALER

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes all labor, materials, equipment, and services necessary to prepare, seal, and protect existing concrete floors as scheduled. The work includes cleaning, repairing, profiling, and applying a durable, slip-resistant, low-gloss or satin finish sealer compliant with ASTM standards..

1.02 REFERENCES

- A. ASTM C 309 – Liquid Membrane-Forming Compounds for Curing Concrete, Type 1, Class A & B.
- B. ASTM F 510 – Standard Test Methods for Skid-Resistance of Floor Surfaces.
- C. ACI 302.1R – Guide for Concrete Floor and Slab Construction

1.03 ACTION SUBMITTALS

- A. Prepare and submit the following in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit manufacturer's specifications and application instructions for each product. Include data substantiating that materials are recommended by manufacturer for applications indicated. Include the following information for installation instructions:
 - 1. Environmental conditions, including temperature, relative humidity, wind conditions and sun exposure under which materials may be applied.
 - 2. Methods and equipment which will be used in application of curing and sealer.
 - 3. Refer to article "Quality Assurance" of this Section for those forms and inspection reports which are to be furnished by the curing and sealer manufacturer's authorized representative.

1.04 QUALITY ASSURANCE

- A. Applicator's Qualifications: Engage an experienced Applicator who employs only persons trained and approved by curing and sealer manufacturer for application of products and issuance of special warranty.
- B. Manufacturer's Qualifications and Responsibilities: Firm regularly engaged in manufacturing curing and sealer which have been used on similar projects with successful results, and that retains factory-trained, authorized technical representatives who are available for consultation and job-site inspections and assistance at no additional cost. Authorized representative to be responsible for the following:
 - 1. Furnish curing and sealer manufacturer's required forms to the applicator and Owner which must be completed for issuance of special warranty; return completed documents to the curing and sealer manufacturer.
 - 2. Attend pre-construction meeting and other meetings as required.
 - 3. Be present during test application, initial application; approve conditions of the substrate prior to sealing; determine actual coverage rates to be used for issuance of special warranty; and approve application techniques and equipment.
 - 4. Be present thereafter, at various intervals during application to ensure that adequate quality controls procedures are in force and that workmanship techniques employed meet manufacturer's recommendations. Frequency of job inspections as mutually agreed upon between applicator, product manufacturer and Architect.
 - 5. Complete required field inspection reports for issuance of special warranty.

1.05 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with requirements specified in Section 01 60 00 – Product Requirements.
- B. Deliver materials to site in sealed, original, labeled containers bearing manufacturer's name, type of material, brand name, and instructions for mixing. Store materials off-ground, and under cover. Conform to any additional recommendations of the manufacturer regarding storage and handling of the materials.

- C. Architect reserves the right to inspect the containers prior to their opening, to review accompanying bills of lading, and to reject materials in opened containers.

1.06 WARRANTY

- A. General: Refer to Division 01 for additional requirements.
- B. Sealer Warranty: Furnish manufacturer's single source labor and materials warranty, signed by an officer of the manufacturing company, for a period of ten (10) years for concrete surfaces. Warranties shall start on date of Substantial Completion. Include in warranty the following:
 - 1. Failure of sealer to prevent damage to concrete evident within the warranty period.
 - 2. Warranty shall not be limited to the original cost of materials and labor.
 - 3. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 – PRODUCTS

2.01 LIQUID FLOOR TREATMENT MATERIALS

- A. Concrete curing and sealing compound. A ready-to-use, water-based acrylic curing and sealing compound for use on new and existing, interior, horizontal concrete surfaces. Product shall conform to:
 - 1. ASTM C 309, Type 1 Class A & B.
 - 2. AASHTO M 148, Type 1, Class A & B
- B. Acceptable Manufacturer/Products:
 - 1. Euclid Chemical Company (The); Aqua-Cure VOX www.euclidchemical.com
 - 2. Dayton Superior "Safe Cure & Seal (J-18) 16%"
 - 3. Nox-Crete "Cure and Seal 100E."
 - 4. Approved equal non-yellowing, acrylic copolymer based curing, sealing and dustproofing meeting ASTM C309, Type 1, Class A & B.
- C. Application Rates:
 - 1. First Coat (Curing): 200 square feet per gallon.
 - 2. Second Coat (Sealer): 400-600 square feet per gallon.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. General: Sealer manufacturer's authorized technical representative shall approved all concrete surfaces after cleaning and prior to application of sealer.
- B. Do not proceed with sealer application until unsatisfactory conditions have been corrected in a manner acceptable to manufacturer's technical representative and the Architect.

3.02 PREPARATION – EXISTING CONCRETE

- A. Profiling:
 - 1. Achieve **Concrete Surface Profile (CSP) 2–3** using shot blasting or diamond grinding.
 - 2. Ensure uniform surface for proper adhesion
- B. Protection: Protect glass, windows, doors, metal trim and other surfaces from contact with sealer by covering with polyethylene sheeting and waterproof masking tape. Exercise care when installing protection material so as to prevent any pin holes or gaps which will allow sealer to get behind the protective surface.
 - 1. Remove protection material immediately upon completion of an area where the chance of overspray or contact with sealer no longer exists.
 - 2. Immediately remove sealer upon contact with metal or glass; use cleaning materials and methods which do not damage surfaces or permanent finishes.

3.03 SEALER APPLICATION

- A. Application (General): Apply sealer in accordance with manufacturer's directions using low pressure airless spray equipment to ensure thorough saturation of concrete surfaces. Do not dilute or alter materials. Apply at same coverage rates as determined on test application as may be required to qualify for special warranty.
 - 1. Apply sealer uniformly, in a 2-step, single application to point of rejection, working it in using a soft bristle broom or mechanical scrubber.
 - 2. Work in this manner until the product begins to gel, usually in 15-30 minutes, then rewet with water and work for another 5-10 minutes.
 - 3. Thoroughly rinse and then squeegee or brush off excess material until dry.

3.04 CLEAN-UP

- A. Remove and dispose of necessary masking materials following completion of curing and sealer application.
- B. Clean-up any over spray from adjacent surfaces with cleaner as recommended by the curing and sealer manufacturer which will not damage surfaces.

END OF SECTION

SECTION 10 14 00
SIGNAGE

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes code required signage and attachment material including the following.
 - 1. Accessibility signage (ADA-compliant)
 - 2. Gender identification signs
 - 3. Directional signs (if applicable)
 - 4. Regulatory signs:
- B. Refer to Signage schedule and details on the drawings.

1.02 REFERENCES

- A. Americans with Disabilities Act (ADA), 2010 Standards for Accessible Design
- B. ICC A117.1 – Accessible and Usable Buildings and Facilities
- C. International Building Code (IBC), current edition
- D. Local and state accessibility codes and health regulations

1.03 ACTION SUBMITTALS

- A. Prepare the following submittals per requirements of Section 01 33 00 – Submittal Procedures.
- B. Submit sign schedule to Architect for final approval prior to fabrication.
- C. Submit shop drawing listing sign styles, lettering and locations, mounting methods, and overall dimensions of all project signage. Drawings for individual letters should indicate proposed spacing.
- D. Submit available colors for all products.
- E. Submit manufacturer's installation instructions for each sign type and material. Include installation template and hardware.

1.04 QUALITY ASSURANCE

- A. ADA compliant containing tactile symbols, raised lettering and Grade 2 braille.
- B. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and protect products in protected location prior to installation.
- B. Package signs, labeled in name groups.
- C. Products shall remain in manufacturer's protective wrappings and shall bear identification of manufacturer.

PART 2 – PRODUCTS

2.01 SIGNAGE MATERIAL

- A. Exterior Signs:
 - 1. Material: UV-resistant acrylic, photopolymer, or aluminum with vandal-resistant coating.
 - 2. Finish: Matte, non-glare surface.
 - 3. Lettering: High contrast (light on dark or dark on light); tactile and raised text with Grade 2 Braille.
 - 4. Graphics: Permanent, UV-stable inks or inlaid materials.

5. Mounting: Tamper-resistant fasteners; wall, post, or surface-mounted as required.
- B. Sign Types:
 1. Restroom Identification Signs (Code-Required):
 - a. Symbols: Universal Men, Women, and/or Unisex pictograms per ADA.
 - b. Text: "MEN", "WOMEN", or "ALL-GENDER RESTROOM", as applicable.
- C. Font: As selected, upper and lower case or all capital letters with letter heights as indicated on architectural drawings, and Owner's signage standards. Text as indicated in the sign schedule.
- D. Braille: Grade II Braille shall be provided.
 1. Braille cells should be dome topped for ease of readability and be the same color as the background.
 2. Sign manufacturer is responsible for assuring accuracy of spelling.
 3. Braille for numbers is directly to the right on same line. Start ¼ inch from edge of last number.
 4. For copy Braille is centered horizontally directly below the word.
- E. Mounting Accessories: Provide as required and recommended by signage manufacturer for a complete installation. Install signs at dimensions indicated on drawings.
- F. Adhesives and Fasteners: Type recommended by the signage manufacturer to meet specified general and structural support criteria. Exact identification of adhesives and fasteners shall be noted on shop drawings, including data describing method of application.

2.02 IDENTIFICATION SIGNAGE

- A. Refer to signage schedule on the drawings.

PART 3 – EXECUTION

3.01 SIGNAGE INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install signs after doors and walls are finished, in locations indicated. Where locations are to be determined in the field, the Contractor shall consult with the Architect prior to beginning installation.
 1. For signs to be mounted on walls, mechanically secure signs near corners with vandal-resistant fasteners. Fastener head color/ finish should match the field color of the signage.
 2. Use tamper-resistant fasteners.
 3. Mount signs plumb, level, and in alignment with adjacent work.
 4. Install tactile signs per ADA and ICC A117.1 mounting height and location requirements.
- C. Refer to schedule and drawing for mounting locations. Unless otherwise noted, signs will occur outside of the room listed.
 1. Verify all locations and heights with the Architect.
 2. Protect signs from damage until final acceptance.

3.02 SIGN SCHEDULE

- A. This preliminary sign schedule shall be reviewed and approved by the Owner prior to fabrication. Refer to drawings for location by Sign Tag.

END OF SECTION

SECTION 10 21 00
TOILET COMPARTMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Headrail (overhead) braced phenolic toilet compartments.
 - 2. Phenolic core urinal screens.
 - 3. Stainless steel hardware, including hinges, brackets, latches, and door pulls.
 - 4. Accessories: coat hooks, bumper guards, and privacy panels as indicated.
- B. Related Sections:
 - 1. Section 10 28 13 – Toilet Accessories: for accessories mounted to toilet compartments.
 - 2. Schedule of Finishes and Legend on the drawings.

1.02 REFERENCES

- A. ICC/ANSI A117.1 - Accessible and Usable Buildings and Facilities, as applicable to toilet compartments designated accessible.
- B. ASTM E84 – Surface Burning Characteristics of Building Materials.

1.03 ACTION SUBMITTALS

- A. Prepare and submit the following in accordance with Section 01 33 00 – Submittal Procedures”
- B. Product data: Manufacturer’s catalog cuts of typical panel, pilaster, door, hardware, accessory and fastening.
- C. Submit shop drawings indicating partition plan and elevation views, dimensions, details of wall and floor supports, door swings, and instructions for installation of anchorage devices built into other work.
- D. Sample Warranty: Meet or exceed provisions specified by this Section. Include manufacturer’s exclusions and limitations.

1.04 QUALITY ASSURANCE

- A. Components of toilet compartments shall be sourced from one single source manufacturer who certifies that materials meet or exceed specifications.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25-75.
 - 2. Smoke-Developed Index: 450 or less.

1.05 PROJECT CONDITIONS

- A. Take field measurements prior to preparation of shop drawings and fabrication, to ensure proper fitting of work.
- B. Verify that adequate blocking exists. If necessary, furnish inserts and anchorages which must be built into other work for installation of toilet compartments and related work; coordinate delivery with other work to avoid delay.
- C. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the project site in the manufacturers original containers with labels indicating brand names, colors and quality designations, legible and intact.
- B. All doors, panels and pilasters shall arrive at the job site with factory applied protective masking.
- C. Store and protect accepted materials in accordance with the manufacturer's direction and recommendations.

1.07 WARRANTY

- A. Special Manufacturer's Warranty: Provide manufacturer's standard form in which manufacturer warrants against defects in materials and workmanship during the following period:
 - 1. Phenolic-Core Toilet Partitions: 25 years.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: Hadrian Manufacturing, Inc. Headrail (Overhead) Braced Phenolic Toilet Partition System.
- B. 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. General Partitions
 - 2. Scranton Products.
 - 3. Bradley.
 - 4. Metpar.
- C. Toilet-Compartment Style: Floor-mounted, overhead braced.

2.02 MATERIALS

- A. Zinc Aluminum Magnesium and Copper Alloy (Zamac): ASTM B86.
- B. Stainless Steel Sheet: ASTM A240 or A666, 300 series.
- C. Stainless Steel Castings: ASTM A 743/A 743M.
- D. Aluminum: ASTM B221.

2.03 COMPARTMENT COMPONENTS

- A. Standard: 58-inch-high doors and panels.
 - 1. Basis of Design Product: Hadrian Standard.
 - 2. Style: Headrail braced.
- B. Phenolic-Core Urinal Screens: To match panels in construction and finish.
 - 1. Basis of Design Product: Hadrian Urinal Screen.
 - 2. Wall hung
- C. Phenolic Door, Panel, and Pilaster Construction, General: Decorative surface papers impregnated with melamine resins, pressed over kraft paper core sheets impregnated with phenolic resin and bonded together under high pressure and temperature.
- D. Doors and Pilasters: No-sightline interlocking doors and pilasters. 3/4-inch- thick with no sightline rebate and 45-degree chamfered edges.
- E. Partition Panels: 1/2-inch- thick, straight cut with 45-degree chamfered edges.
- F. Headrails: 1 inch by 1.75 inch, #4 brushed finish, extruded aluminum with anti-grip design. Minimum 0.060-inch wall thickness. Securely attach to wall and pilasters with manufacturer's fittings to make a rigid installation.

- G. Floor Shoes: 4-inch- high stainless steel.

2.04 COMPARTMENT HARDWARE AND ACCESSORIES

- A. Hinges: Surface mounted, 11-gauge stainless steel with adjustable cams for self-closing operation. Attach to doors and pilasters with manufacturer's standard stainless steel fasteners.
- B. Indicator Latches: Manufacturer's standard brushed nickel zamac indicator latch assembly with antimicrobial coating showing red in the window when in locked position and green when unlocked.
- C. Door Pulls: Manufacturer's standard brushed nickel zamac pulls with antimicrobial coating at outswinging doors that comply with accessibility requirements.
- D. Wall Connections: Continuous stainless steel channels at panel to wall, panel to pilaster, and pilaster to wall connections, Grade 304 stainless steel, #4 brushed finish.
- E. Coat Hooks:
 - 1. Inswing Doors: Stamped stainless steel door hook, Grade 304 stainless steel, #4 brushed finish, combined coat hook and bumper.
 - 2. Outswing Doors: Stainless steel flat coat hook, Grade 304 stainless steel, #4 brushed finish.
- F. Fasteners: Manufacturers standard stainless steel fasteners, vibration resistant, twin lead, with pan heads.
- G. Other Partition Mounted Toilet Accessories: Specified Section 10 28 13.

2.05 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; tested 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: 450 or less.
- B. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.06 FABRICATION

- A. General: Fabricate toilet compartments to sizes indicated on Drawings. Coordinate requirements and provide for attachment of toilet accessories. Provide cutouts for through-partition toilet accessories where required.
- B. Doors: Pre-drill holes for latches and hinges. Factory install rubber bumpers secured with press fit and adhesive.
- C. Pilasters: Pre-drill holes for hinges.
- D. Anchors: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- E. Specifier: Retain paragraph below and revise to suit Project; verify requirements of authorities having jurisdiction.
- F. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide clear opening for compartments designated as accessible.

2.07 FINISHES

- A. Refer to Interior Finish Schedule on the drawings.
- B. Stainless Steel: No. 4 Satin finish.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify spacing of plumbing fixtures and drains.
- C. Verify correct location of built-in framing, anchorage, and bracing, where required.
- D. Beginning of installation means acceptance of existing surfaces.

3.02 INSTALLATION

- A. Install compartments and screens secure, plumb, and level and in accordance with manufacturer's instructions. Install units rigid and straight. Secure units in position with manufacturer's recommended anchoring devices penetrating structural floor to depth indicated in manufacturer's written instruction.
- B. Headrail-Braced Compartments: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster. Adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact

3.03 ADJUSTING/CLEANING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 15 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.
- B. Replace damaged or scratched materials with new materials.
- C. Remove protective maskings. Clean surfaces in accordance with manufacturer's recommendations.
- D. Protect installation during remainder of construction.

END OF SECTION

SECTION 10 28 13
TOILET ACCESSORIES

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes toilet accessories and includes:
 - 1. Furnish toilet accessory templates, to locate anchorage reinforcement, to trades responsible.
 - 2. Installing toilet accessories furnished by Owner.
- B. Related Sections:
 - 1. Section 06 10 00 – Rough Carpentry: Wood blocking for support of toilet and bath accessory items.
 - 2. Section 09 29 00 – Gypsum Board: For required wood or metal supports within metal stud wall system.
 - 3. Section 09 30 13 – Ceramic Tiling.
 - 4. Refer to Drawings for toilet accessory schedule and accessory mounting heights.

1.02 REFERENCES

- A. American with Disabilities Act (ADA), ICC/ANSI A117.1 – Accessible and Usable Buildings and Facilities.
- B. Ohio Building Code – Chapter 11 – Accessibility.

1.03 SYSTEM DESCRIPTION

- A. Toilet accessories shall be provided to conform with ICC A117.1 and State and Local Regulations. These requirements supersede Technical Specifications in this Section.
 - 1. Product data on accessories indicating quality, describing size, finish, details of function, attachment methods.
 - 2. Schedule indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.
 - 3. Setting drawings, templates, instructions, and directions for installation of anchorage devices and cut-out requirements in other work.
 - 4. Maintenance instructions including replaceable parts and service recommendations.

1.04 ACTION SUBMITTALS

- A. Prepare the following submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings:
 - 1. Plans: Locate each specified unit in project.
 - 2. Elevations: Indicate mounting height of each product.
 - 3. Details: Indicate anchoring and fastening details, required locations and types of anchors and reinforcement, and materials required for installation of specified products.
- C. Schedule: Submit a schedule of Owner-furnished, Contractor-installed accessories, clearly identifying which items are Owner-furnished and which are Contractor-furnished and installed.

1.05 INFORMATIONAL SUBMITTALS

- A. Literature: Manufacturer's product data sheets, for each item furnished hereunder.
- B. Schedule: Complete schedule, indicating types, quantity, and model numbers of accessories for each location in which the accessories will be installed.
- C. Selection samples: Sample color chips indicating each manufacturer's full range of colors available for selection by Architect.
- D. Verification samples: Complete units, as requested by Architect.

- E. Manufacturer's Warranty:
 - 1. Deliver to the Owner upon completion of the work of this Section, applicable manufacturer's standard warranties.
- F. Closeout Submittals: Warranty, issued and executed by manufacturer, and countersigned by Contractor.
 - 1. One set of special adjusting or installation tools unique to the products furnished under this section.
 - 2. Keys to accessories furnished under this section.

1.06 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 3, provide products of same manufacturer unless otherwise scheduled or approved by Architect.
- B. Furnish accessory manufacturer's inserts and anchoring devices for use in masonry or concrete; coordinate delivery with other work to avoid delay.
- C. Design, fabricate, and install handicapped toilet compartment grab bars capable of withstanding a downward dead load of at least 250 lb. per foot without damage or permanent set to grab bar members or anchors.
- D. Exercise care to prevent damage to existing surfaces or equipment. At time of completion, accessories shall be in perfect condition, well anchored, and in proper alignment at the location indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver accessories in manufacturer's original containers and store in same until installation.
- B. Owner-Furnished Accessories:
 - 1. Owner will deliver to project site in original packaging.
 - 2. Contractor shall receive, store, and protect until installation.
- C. Keys: Furnish 2 keys for each accessory item required to have a lock. Seal in clearly marked envelopes and turn over to Owner prior to building acceptance.

1.08 PROJECT CONDITIONS

- A. Coordinate accessory locations, installation, and sequencing with other work to avoid interference and to assure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

1.09 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. Coordinate locations, dimensions, and other pertinent details with installation of backing, blocking, and electrical connections.

1.10 WARRANTY

- A. Manufacturer's warranty for Contractor-furnished accessories.
- B. Installation warranty: Contractor shall warrant installation of all accessories, including Owner-furnished items, against defects due to poor workmanship for one year after Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Toilet accessories shall be manufactured by Bobrick Washroom Equipment, Inc., Clifton Park, NY; specified as the type, size and function as described in the Toilet Accessory Schedule.

- B. 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. Bradley Corporation, Menomonee Falls, WI
 - 2. American Specialties Inc., Yonkers, NY

2.02 MATERIALS: TOILET ACCESSORIES

- A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19 flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
 - 1. Provide tempered glass, where indicated.
- H. Galvanized Steel Mounting Devices: ASTM A153, hot dip galvanized after fabrication.
- I. Fasteners and Anchors: Non-corrosive, theft-resistant, screws, bolts and other fastening devices of same material as accessory unit or of galvanized steel where concealed.
 - 1. Provide mounting kits with stainless steel screws for accessories requiring same.
 - 2. Mounting kits shall include toggle nuts for hollow walls and expansion shields for solid walls. Provide 2 fasteners at each mounting plate.
 - 3. Provide 12 gauge, 3 inches wide, steel concealed anchor plates with tapped holes for installation of grab bars on walls constructed with metal studs.
 - 4. Provide concealed anchors for installation of grab bars on solid walls. Anchor assembly shall consist of tapped 12 gauge anchor plate, 10 gauge back plate, and 3/8 inch diameter thru-wall bolt.
- J. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing and resupply.

2.03 FABRICATION

- A. Recessed and modified surface mounted dispensing and disposal cabinets shall be constructed as follows:
 - 1. Exposed surfaces shall be of 22 gauge type 304 stainless steel with concealed stainless steel piano hinge on doors.
 - 2. There shall be 1/4 inch return on face trim.
 - 3. Each cabinet shall be provided with pin tumbler type locks (to match existing if possible) and two keys with the exception of the napkin vendors, which shall have door locks and coin box locks, keyed differently.
 - 4. Cabinets shall have a common fascia with grain on exposed surfaces, lapped in one direction to a #4 satin finish.
 - 5. Dispensers shall be equipped with sight or mechanical gauge for easier refill.
 - 6. Disposals shall be completely enclosed and removable plastic; waste receptacles shall be constructed of heavy duty polyvinyl.
- 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 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

- C. Mirror Unit Hangers: Provide system for mounting mirror units that will permit rigid, tamperproof, and theft-proof installation, as follows:
 - 1. One piece, galvanized steel, wall hanger device with spring action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
- D. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide minimum of 6 keys to Owner's representative.

2.04 FACTORY FINISHING

- A. Ferrous metals: Clean and treat, spray apply one coat of baked-on rust and moisture-resistant primer, followed by two coats of baked-on synthetic enamel, in selected colors. Ensure that finish coating is uniform in color intensity and degree of gloss, throughout.
- B. Chrome/Nickel Plating: ASTM 456, Type SC2, satin finish.
- C. Stainless steel: Number 4 satin finish, except as otherwise specified above under the Article entitled "Toilet Accessories".

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that site conditions are ready to receive work and dimensions are as indicated on shop drawings.
- B. Confirm blocking and supports are correctly located.
- C. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site at appropriate time for building-in.
- B. Provide templates and rough-in measurements as required.
- C. Verify exact location of accessories for installation.

3.03 INSTALLATION

- A. Install accessories in accurate locations as noted on drawings; securely anchored to substrate surfaces.
- B. Install items in accordance with manufacturer's recommendation.
 - 1. Wall mounted items to be secured with devices suitable for the wall construction. Lead, plastic, wood, or fiber plugs are not acceptable.
 - 2. Accessories not located on drawings shall be installed where directed by the Architect.
 - 3. Provide theft resistant type exposed fasteners.
- C. Install accessories plumb, level, straight, and properly aligned with adjacent surfaces. Mount at heights compliant with ADA and project requirements.
 - 1. Comply with ANSI A117.1 accessibility requirements.
 - 2. Install accessory units to accommodate the physically handicapped, with operating areas of coin slots, openings for dispensers and waste not more than 40 inches above the floor.
 - 3. Mount grab bars to comply with specified performance requirements. Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.
- D. Accessories shall have concealed mounting and fastening devices for types of partitions as follows:
 - 1. Concrete masonry units: Integral anchors.
 - 2. Gypsum board and metal stud partitions: Screws or bolts secured to metal plates anchored to studs.
- E. Coordinate installation of accessories in toilet compartments and work of other trades to allow proper operation. Notify the Architect in case of conflict.

3.04 ADJUSTING AND CLEANING

- A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
- B. Clean all exposed surfaces in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.
- C. Do not permit use of accessories until acceptance by Owner.

END OF SECTION

SECTION 12 31 00
MANUFACTURED METAL CASEWORK

PART 1 – GENERAL

1.01 SUMMARY

- A. Section includes.
 - 1. Metal casework, including:
 - a. Base cabinets.
 - b. Wall cabinets.
 - c. Tall storage cabinets.
 - 2. Countertops
 - 3. Hardware and accessories.
 - 4. Factory-applied finishes.
 - 5. Installation and adjustment.

1.02 REFERENCES

- A. ANSI/BIFMA X5.9 – Storage Units.

1.03 SUBMITTALS

- A. Prepare and submit the following in accordance with Section 01 33 00 – Submittal Procedures:
- B. Product Data: Manufacturer's catalog data for each type of cabinet, finish, and accessory.
- C. Shop Drawings: Indicate casework layout, dimensions, openings, clearances, and coordination requirements with adjacent construction.
- D. Samples:
 - 1. Finish samples illustrating powder-coat texture and standard color groupings.
 - 2. One hardware sample of each exposed type.
- E. Test Reports: Manufacturer's SEFA 8M compliance test results.
- F. Warranty: Copy of manufacturer's standard warranty.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5 years producing laboratory-grade metal casework.
- B. Installer Qualifications: Approved by manufacturer with minimum 10 completed installations of similar scope.
- C. Mock-Up: Provide one base cabinet for review prior to fabrication. Accepted unit may remain as part of Work.

1.05 PERFORMANCE REQUIREMENTS

- A. **Structural Integrity:** Cabinets must withstand daily laboratory use, including full load of stored materials, without permanent deformation.

Feature

Performance Requirement

Cabinet Body

Support full design load without permanent deformation

Drawers

Smooth, full-extension operation; support 100–150 lb

Shelves

Adjustable; support specified load

<u>Feature</u>	<u>Performance Requirement</u>
Doors / Hinges	Smooth operation; maintain alignment
Drawer Slides	Full-extension, durable under repeated use
Finish / Coating	Resistant to abrasion, chemicals, impact
Locks / Hardware	Function properly, secure
Edges & Safety	No sharp edges; reinforced hardware points
Installation / Alignment	Cabinets plumb, level, square; minimal gaps
Environmental Resistance	Maintain performance under lab conditions

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver or install metal casework until the following conditions are met:
 - 1. Ceiling, and overhead work is completed.
 - 2. Painting and floor finishes work are completed.
- B. Store completed metal casework protected from the weather.
- C. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective cover.
- D. The supplier of the metal casework is responsible for removing any waste or refuse resulting from the installation work pertaining to casework; thereby leaving the project site clean and free of debris. Trash container(s) to be provided by the general contractor.

1.07 WARRANTY

- A. Furnish a written warranty that Work performed under this Section shall remain free from defects as to materials and workmanship for a period of (2) years from date of substantial completion. Defects in materials and workmanship that may develop within this time are to be replaced without cost or expense to the Owner.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Garage Living, Columbus, OH.
 - 1. Signature Steel Cabinetry
- B. Substitutions: Per Section 01 25 00 – Substitution Procedures. Comparable products of other manufacturers as approved by Architect during the bidding phase.

2.02 MATERIALS

- A. Cabinet Construction: 18-gauge steel, fully welded construction.
- B. Shell: Single-wall cabinet bodies.
- C. Finish: Powder-coated enamel; color per project schedule
- D. Hardware: Full-length built-in handles in metallic silver accent
- E. Countertops: Stainless steel
- F. Drawers: 18-gauge front, double-wall construction.
- G. Drawer Slides: Full-extension, SEFA-compliant, epoxy-coated steel slides, minimum 100 lb load rating.
- H. Hinges: European style.

- I. Shelves: Adjustable formed steel with shelf clips, 100 lb. minimum load capacity.

2.03 CABINET TYPES

<u>TYPE</u>	<u>DESCRIPTION</u>	<u>DIMENSIONS</u>	<u>FEATURES</u>
Wall Cabinets	Adjustable shelving, lockable doors optional	30-42" H x 12-18" D	Concealed hinges, uniform reveal
Base Cabinets	Adjustable shelving, Drawers, lockable doors	34-36" H x 24" D	Full-extension drawers, reinforced powder-coated body
Tall Cabinets	Full-height storage, adjustable shelving	84-96" H x 24" D	Lockable doors, reinforced structure

2.04 FINISHES

- A. Coating: Factory-applied, baked-on epoxy powder coat.
- B. Performance: Finish shall resist abrasion, chemicals, and staining in compliance with SEFA 8M.
- C. Color: To be selected from manufacturer's standard range by Architect.

2.05 FABRICATION

- A. Cabinet Construction:
1. Flush overlay doors and drawer fronts.
 2. Welded construction per manufacturer standards.
 3. Reinforce hardware attachment points.
 4. Concealed fasteners, smooth edges, reinforced corners.
 5. Doors and drawers operate smoothly with uniform reveal.
- B. Drawer Suspension: Quiet-operating, full-extension, self-closing mechanism optional.

2.06 ACCESSORIES

- A. Locks: Cylinder locks for doors and drawers; keyed alike.
- B. Pulls: stainless steel.
- C. Cabinet Tops: Stainless steel

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Do not begin installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and approved shop drawings.
- B. Comply with installation requirements of casework manufacturer. Install level, plumb, and true; shim as required, using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- C. Ensure seamless alignment of doors and drawers. Locate specialty accessories as required..

- D. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 - 1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than two fasteners per side.
- E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- F. Adjust casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.03 CLEANING AND PROTECTION

- A. Clean shop-finishes, touch-up as required and remove and refinish damaged or soiled areas.
- B. Touch up abraded areas with manufacturer's finish repair kit.
- C. Provide necessary protective measures to prevent damage of casework and equipment from exposure to other construction activity. Installer shall advise Contractor of procedures and precautions required to protect metal casework, including temperature/humidity conditions that must be maintained during the remainder of the construction period.

END OF SECTION

SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems
 - 2. GPT
 - 3. Metraflex
 - 4. Pipeline Seal and Insulator.

- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. 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.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07.
- E. 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 for firestopping specified in Division 07.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls and Concrete Slab on Grade:
 - a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

END OF SECTION 22 05 17

SECTION 22 05 18

ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- D. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- E. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed or exposed-rivet hinge; and spring-clip fasteners.

2.2 FLOOR PLATES

- A. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

- B. Install escutcheons with inside diameter closely fitting around outside diameter of piping and piping insulation and with outside diameter completely covering opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Uninsulated Piping: One-piece steel or split-plate steel.
 - c. Insulated Piping: One-piece stamped steel or split-plate stamped steel.
 - 2. Escutcheons for Existing Piping:
 - a. Uninsulated Piping: Split-plate, stamped steel.
 - b. Insulated Piping: Split-plate, stamped steel.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with inside diameter closely fitting around piping and piping insulation and with outside diameter completely covering opening.
 - 1. New Piping: Split floor plate.
 - 2. Existing Piping to Remain: Split floor plate.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 22 05 18

SECTION 22 05 19

METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Thermowells.
5. Dial-type pressure gauges.
6. Gauge attachments.
7. Test plugs.
8. Test-plug kits.
9. Sight flow indicators.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates:** For each type of meter and gauge, from manufacturer.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:** For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ashcroft Inc.
2. Ernst Flow Industries.
3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Noshok.
7. Palmer Wahl Instrumentation Group.
8. REOTEMP Instrument Corporation.
9. Tel-Tru Manufacturing Company.

10. Terice, H. O. Co.
 11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 12. Weiss Instruments, Inc.
 13. WIKA Instrument Corporation - USA.
 14. Winters Instruments - U.S.
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.
- D. Dial: Non reflective aluminum with permanently etched scale markings and scales in deg F.
- E. Connector Type(s): Union joint, adjustable angle rigid, back and rigid, bottom, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass or plastic.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1.5 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

- A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Terice, H. O. Co.
 - g. Weiss Instruments, Inc.
 2. Standard: ASME B40.200.
 3. Case: Sealed type, cast aluminum or drawn steel; 5-inch nominal diameter.
 4. Element: Bourdon tube or other type of pressure element.
 5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
 7. Pointer: Dark-colored metal.
 8. Window: Glass or plastic
 9. Ring: Stainless steel
 10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device rigid, back and rigid, bottom; with ASME B1.1 screw threads.
 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

- a. Design for Thermowell Installation: Bare stem.

- 12. Accuracy: Plus or minus 1 percent of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

- 1. Manufacturers: Ashcroft, Terrice, Weiss
- 2. Standard: ASME B40.200.
- 3. Case: Cast aluminum; 6-inch nominal size.
- 4. Case Form: Straight unless otherwise indicated.
- 5. Tube: Glass with magnifying lens and blue or red organic liquid.
- 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C
- 7. Window: Glass or plastic.
- 8. Stem: Aluminum or brass and of length to suit installation.
- 9. Design for Thermowell Installation: Bare stem.
- 10. Connector: 3/4 inch, with ASME B1.1 screw threads.
- 11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.4 THERMOWELLS

A. Thermowells:

- 1. Standard: ASME B40.200.
- 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
- 3. Material for Use with Copper Tubing: Brass, type 304 stainless steel, or type 316 stainless steel.
- 4. Material for Use with Steel Piping: Type 304 stainless steel or type 316 stainless steel..
- 5. Type: Stepped shank unless straight or tapered shank is indicated.
- 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
- 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
- 8. Bore: Diameter required to match thermometer bulb or stem.
- 9. Insertion Length: Length required to match thermometer bulb or stem.
- 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
- 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.5 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:

- 1. Manufacturers: Ashcroft, Terrice, Weiss
- 2. Standard: ASME B40.100.
- 3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 6. Movement: Mechanical, with link to pressure element and connection to pointer.
- 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.

- 8. Pointer: Dark-colored metal.
- 9. Window: Glass or plastic.
- 10. Ring: Metal.
- 11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.6 GAUGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.7 TEST PLUGS

- A. Manufacturers: Trerice, Weiss, Watts
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.8 SIGHT FLOW INDICATORS

- A. Manufacturers: Dwyer, OPW, Archon Industries
- B. Description: Piping inline-installation device for visual verification of flow.
- C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- D. Minimum Pressure Rating: 125 psig.
- E. Minimum Temperature Rating: 200 deg F.
- F. End Connections for NPS 2 and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
- H. Install remote-mounted pressure gauges on panel.
- I. Install valve and snubber in piping for each pressure gauge for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
 - 4. Inlet and outlet of each remote domestic water chiller.
- L. Install pressure gauges in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Direct metal case, vapor-actuated type.
 - 3. Industrial-style, liquid-in-glass type.
 - 4. Direct-mounted, light-activated type.
 - 5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.
- B. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be the following:

1. Liquid-filled, bimetallic-actuated type.
2. Direct mounted, metal case, vapor-actuated type.
3. Industrial-style, liquid-in-glass type.
4. Direct mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.
- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.
- C. Scale Range for Domestic Cooled-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.

3.6 PRESSURE-GAUGE SCHEDULE

- A. Pressure gauges at discharge of each water service into building shall be one of the following:
 1. Liquid-filled, direct mounted, metal case.
 2. Sealed, direct mounted, plastic case.
 3. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.
- B. Pressure gauges at inlet and outlet of each water pressure-reducing valve shall be the following:
 1. Liquid-filled, direct mounted, metal case.
 2. Sealed, direct mounted, plastic case.
 3. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.
- C. Pressure gauges at suction and discharge of each domestic water pump shall be the following:
 1. Liquid-filled, direct mounted, metal case.
 2. Sealed, direct mounted, plastic case.
 3. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 160 psi and 0 to 1100 kPa.
- B. Scale Range for Domestic Water Piping: 0 to 160 psi and 0 to 1100 kPa.

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.
 - 4. Combination balancing and shutoff valves.
 - 5. Gate valves.
 - 6. Globe valves.
 - 7. Chainwheels.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NPS: Nominal Pipe Size
- D. OS&Y: Outside screw and yoke.
- E. SWP: Steam working pressure.

1.3 SUBMITTALS

- A. Product Data: For each type of valve indicated, include: Body, seating and trim materials; valve design; pressure and temperature classifications; end connections, arrangements; dimensions and required clearances. Submit pressure drop curves for no-slam check valves. Include a list indicating valve type and its piping system application. Include rated capacities; shipping and operating weights and furnished specialties and accessories.
- B. Contract Closeout Information:
 - 1. Valve chart indicating valve identification number, valve type, service, manufacturer and model number, and location of valve.
 - 2. Operating and maintenance manuals.

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 adjoining couplings.
- B. UL Compliance:

1. NSF-61 for valves in potable water systems.
2. NSF-372 for low-lead requirements.

C. 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.
4. ASME Boiler Code Specifications for Boiler Room valves.

D. ASTM Compliance:

1. ASTM B62 for 125 psi and 150 psi saturated steam rated valve pressure containing parts.
2. ASTM B61 for 200 psi and 300 psi valves with metallic seats.

E. Factory test all valve bodies, shells and seats per MSS requirements at a minimum.

F. Iron Body Valves

1. Pressure-Containing Parts: ASTM A126, Grade B or ASTM A536, Grade 65-45-12.
2. Face-to-Face and End-to-End Dimensions: ANSI B16.10.
3. Design, Workmanship, Materials, Testing: MSS SP-70, 71, 85.

G. Butterfly Valves

1. Face-to-Face and End-to-End Dimensions: MSS SP-67.

H. Valve Stems: ASTM B371, Alloy C69400; ASTM B371, Alloy C65100H04 (rolled silicon brass); or other material equally resistant to dezincification.

I. Valve Bypass and Drain Connections: MSS SP-45.

J. Pressure casting shall be free of impregnating materials, no welding of iron allowed.

K. Manufacturer's name or trademark and working pressure stamped or cast into body.

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, grooved ends, and weld ends.
3. Set gate and globe valves closed to prevent rattling.
4. Set ball 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 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
- B. Ball, Butterfly, Check, and Globe Valves:
 - 1. Milwaukee, Hammond, Crane, NIBCO, Apollo, Watts, Tyco, Mueller or Victaulic.
- C. Combination Balancing and Shutoff Valves:
 - 1. Armstrong, Bell & Gossett, Griswold, Taco, IMI Hydronic Engineering or Victaulic.
- D. Gate, Check, and Globe Valves:
 - 1. Milwaukee, Hammond, Crane or Flowserve.

2.2 GENERAL REQUIREMENTS FOR VALVES

- A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures. Valves shall be rated for pressures and temperatures no less than 20% over that of the piping system in which they are installed. Account for piping system pressure tests when selecting component ratings.
- 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. Hand lever: For quarter-turn valves NPS 6 and smaller.
 - 4. 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. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. 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.
 - 3. Threaded: With threads according to ASME B1.20.1.
- F. Combination Balancing and Shutoff Valves:
 - 1. Install where shown on Drawings. Valves shall be designed and used only for balancing, not shutoff.
 - 2. Provide a means for connecting to a portable differential pressure meter for readout. A portable pressure gauge, hoses and flow curves shall be provided in a portable test kit.
 - 3. On sizes 2-1/2" and larger, valve size, capacity and operating pressure must comply with ASME Boiler Pressure Vessel Code: Section IV.
 - 4. Refer to manufacturer's recommendations for upstream and downstream straight piping lengths.

5. Provide an additional "separate" shutoff valve upstream of combination valves for system/component shutoff.

2.3 BALL VALVES

A. Bronze Ball Valves:

1. Description:
 - a. Standard: MSS SP-110.
 - b. ANSI Class: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded or Soldered for copper piping.
 - g. Seats: Reinforced PTFE.
 - h. Stem: Stainless steel.
 - i. Ball: Chrome plate ball, vented.
 - j. Port: Full.
 - k. Operator: Hand Lever.

2.4 BUTTERFLY VALVES

A. Single-Flange, Butterfly Valves:

1. 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.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
 - h. Operator: 10 Position Hand Lever for less than 6", Gear Actuator for 6" and larger.
 - i. Other: Valves and Seats shall be rated for 150 psi shutoff during dead-end service, without downstream piping or flange.

B. Grooved-End, Butterfly Valves (Cast Brass):

1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 300 psig.
 - c. Body Material: Cast brass.
 - d. Stem: Two-piece stainless steel.
 - 1) Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.
 - e. Disc: Aluminum-bronze.
 - f. Seal: Pressure-responsive EPDM.
 - g. Copper-tube dimensioned grooved ends.

C. Grooved-End, Butterfly Valves (Iron):

1. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 300 psig (24" and smaller).
- c. Body Material: Coated, ductile iron.
- d. Stem: Two-piece stainless steel.
 - 1) Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.
- e. Disc: Coated, ductile iron.
- f. Seal: EPDM.
 - 1) Pressure responsive in sizes 12" and smaller.

2.5 CHECK VALVES

A. Lift Check Valves:

1. Description:

- a. Standard: MSS SP-80, Type 1.
- b. ANSI Class: 125
- c. CWP Rating: 200 psig.
- d. Body Design: Vertical flow.
- e. Body Material: ASTM B 61 or ASTM B 62, bronze.
- f. Ends: Threaded or Soldered for copper piping.
- g. Disc: Reinforced PTFE.
- h. Cap: Threaded.

B. Globe Body Silent Check Valves:

1. Description:

- a. ANSI Class: 125
- b. Body Material: ASTM A 48, Class 35, cast iron.
- c. Disc Material: Cast Iron with Bronze Face Rings
- d. Ends: Flanged or Wafer.
- e. Trim: Bronze.
- f. Spring Material: Stainless Steel T304 (ASTM A 276).

C. Bronze Swing Check Valves:

1. Description:

- a. Standard: MSS SP-80, Type 3.
- b. ANSI Class: 125
- c. CWP Rating: 200 psig.
- d. Body Design: Horizontal flow.
- e. Body Material: ASTM B 62, bronze.
- f. Ends: Threaded or Soldered for copper piping.
- g. Disc: Reinforced PTFE.
- h. Cap: Threaded.

D. Iron Swing Check Valves:

1. Description:

- a. Standard: MSS SP-71, Type I.
- b. ANSI Class: 125
- c. CWP Rating: 200 psig.
- d. Body Design: Clear or full waterway.

- e. Body Material: ASTM A 126, cast iron.
- f. Ends: Flanged.
- g. Trim: Bronze.
- h. Gasket: Asbestos free.
- i. Cap: Bolted.

E. Cast Steel Swing Check Valves:

1. Description:

- a. ANSI Class: 300
- b. Body Material: ASTM A 216, cast steel.
- c. Disc Material (2" to 4"): Steel (ASTM A 217, Gr. CA-15).
- d. Disc Material (6" to 12"): Steel with Hard Faced (ASTM A 216, Gr. WCB).
- e. Ends: Flanged.
- f. Seat Ring Material: Stellite hard facing over plain carbon steel.
- g. Bonnet: Bolted.

F. Grooved-End, Spring-Assisted Swing Check Valves

1. Description:

- a. CWP Rating:
 - 1) 12" and smaller: 300 psig.
 - 2) 14" to 24": 230 psig.
- b. Body Material: ASTM A 536, ductile iron.
- c. Seal: EPDM.
- d. Disc: Spring-operated, ductile iron or stainless steel.
- e. Installation: Vertical or horizontal.

2.6 COMBINATION BALANCING AND SHUTOFF VALVES

A. Calibrated Ball Type or Venturi Combination Balancing and Shutoff Valves:

1. Description:

- a. CWP Rating: 125 psig.
- b. Body Material: Brass or Bronze (ASTM B 62)
- c. Ends: Flanged, Threaded or Soldered for copper piping.
- d. Seat Material: Double-seated Teflon.
- e. Ball Material: Stainless Steel.
- f. Stem Material: Brass/Bronze sealed with blow-out proof EPDM O-Ring.
- g. Operator: Lever with memory stop.

2.7 GATE VALVES

A. Bronze Gate Valves:

1. Description:

- a. Standard: MSS SP-80, Type 2.
- b. ANSI Class: 150
- c. CWP Rating: 300 psig.
- d. Body Material: ASTM B 62, cast bronze.
- e. Ends: Threaded.
- f. Stem: Non-Rising.

- g. Disc: Solid wedge; bronze.
- h. Packing: Asbestos free.
- i. Bonnet: Union
- j. Operator: Hand Wheel-Malleable iron.

B. Iron Gate Valves:

1. Description:

- a. Standard: MSS SP-70, Type I.
- b. ANSI Class: 125
- c. CWP Rating: 200 psig.
- d. Body Material: ASTM A 126, cast iron.
- e. Ends: Flanged.
- f. Wedge and Seat Rings Material: Cast bronze.
- g. Disc: Solid Wedge-Cast iron.
- h. Packing and Gasket: Asbestos free.
- i. Bonnet: Bolted
- j. Stem: O.S. & Y.
- k. Operator: Hand Wheel-Cast iron.

C. Forged Carbon Steel Gate Valves:

1. Description:

- a. ANSI Class: 300 or 600
- b. Body Material: ASTM A 105, forged carbon steel.
- c. Ends: Flanged or weld.
- d. Seat Ring Material: Hard faced stainless steel (Type 410).
- e. Disc: Solid Wedge-Stainless steel (Type 410).
- f. Bonnet: Bolted
- g. Packing and Gasket: Asbestos free.
- h. Stem: O.S. & Y.
- i. Operator: Hand Wheel-Malleable iron.

D. Cast Steel Gate Valves:

1. Description:

- a. ANSI Class: 300
- b. Body Material: ASTM A 216, cast steel.
- c. Ends: Flanged.
- d. Seat Ring Material: Stellite hard facing over plain carbon steel.
- e. Disc: Stainless steel (ASTM A 217).
- f. Bonnet: Bolted.
- g. Stem: O.S. & Y.
- h. Operator: Hand Wheel-Malleable iron.

2.8 GLOBE VALVES

A. Bronze Globe Valves:

1. Description:

- a. Standard: MSS SP-80, Type 2.
- b. ANSI Class: 150
- c. Body Material: ASTM B 62, bronze.

- d. Ends: Threaded or Flanged.
- e. Stem: Rising.
- f. Disc: 420 Stainless Steel.
- g. Seat Ring Material: 420 Stainless Steel.
- h. Bonnet: Union.
- i. Operator: Hand Wheel-Malleable iron.

B. Iron Globe Valves:

1. Description:

- a. Standard: MSS SP-85, Type I.
- b. ANSI Class: 125
- c. Body Material: ASTM A 126, cast iron.
- d. Disc Material: ASTM B 62; Bronze.
- e. Seat Ring Material: ASTM B 62; Bronze.
- f. Ends: Flanged.
- g. Bonnet: Bolted.
- h. Stem: O.S. & Y.
- i. Operator: Hand Wheel-Cast or malleable iron.

C. Forged Steel Globe Valves:

1. Description:

- a. ANSI Class: 300 or 600
- b. Body Material: ASTM A 105, forged steel.
- c. Disc Material: Loose-Stainless Steel (Type 410).
- d. Seat Material (Class 300): Integral Hard Faced.
- e. Seat Material (Class 600): Renewable Stainless Steel (Type 410)
- f. Ends: Flanged or Butt Weld.
- g. Bonnet: Bolted.
- h. Stem: O.S. & Y.
- i. Operator: Hand Wheel-Malleable iron.

D. Cast Steel Globe Valves:

1. Description:

- a. ANSI Class: 300
- b. Body Material: ASTM A 216, cast steel.
- c. Disc Material: Stainless steel.
- d. Seat Ring Material: Stellite hard facing over plain carbon steel.
- e. Ends: Flanged.
- f. Bonnet: Bolted.
- g. Stem: O.S. & Y.
- h. Operator: Hand Wheel, Hand Lever or Gear Actuator for 6" and larger.

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.
- F. Examine grooved ends for form and cleanliness. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.

3.2 VALVE INSTALLATION

- A. Install valves at locations shown on the Drawings, per the Specifications and in accordance with manufacturer's written instructions.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Unions and flanges for servicing and disconnect are not required in installations using grooved mechanical joint couplings (the couplings shall serve as disconnect points if required).
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with handwheel and stem at or above center of pipe.
- F. Install valves in position to allow full stem movement.
- G. Install chainwheels on operators for all valves located with the lowest portion of its handwheel or lever at 10' or more above finished floor. Extend chains to 5' above finished floor.
- H. 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.
- I. Install Combination Balancing and Shutoff Valves at each branch connection to return main.
- J. Install Start/Stop flow valve for isolation at each branch connection to supply main.
- K. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- L. All check valves should be installed in a location that has smooth and laminar flow conditions.
- M. For swing type check valves, locate valve a minimum of 10 pipe diameters downstream of a reciprocating pump or other turbulence inducing device such as an elbow or tee. Locate elbows, reductions, etc. a minimum of 5 pipe diameters downstream of valve.
- N. For silent type check valves, locate valve a minimum of 4 pipe diameters downstream of a reciprocating pump or other turbulence inducing device such as an elbow or tee. Locate elbows, reductions, etc. a minimum of 3 pipe diameters downstream of valve.

- O. Valves installed in copper lines shall be provided with screwed or flanged adapters with a union installed downstream and within 12" of the valve.
- P. 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 the Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.

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 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.

3.5 PLUMBING SYSTEMS

A. Pipe NPS 2 and Smaller:

- 1. Shutoff: Ball Valves.
- 2. Prevent Backflow: Lift Check Valves or Bronze Swing Check Valves.
- 3. Regulate/Balance Flow: Calibrated Ball Type or Venturi Combination Balancing Shutoff Valves.

B. Pipe NPS 2-1/2 and Larger:

- 1. Shutoff: Butterfly Valves.
- 2. Prevent Backflow: Iron Swing Check Valves or Globe Body Silent Check Valves.
- 3. Regulate/Balance Flow: Venturi Butterfly or Venturi Globe Type Combination Balancing and Shutoff Valves.

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. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal-hanger shield inserts.
 - 7. Fastener systems.
 - 8. Pipe stands.
 - 9. Pipe positioning system.
 - 10. Equipment supports.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of 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. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product indicated.
 - 2. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

- a. Trapeze pipe hangers.
 - b. Metal framing systems.
 - c. Fiberglass strut systems.
 - d. Pipe stands.
 - e. Pipe positioning system.
 - f. Equipment supports.
 - 3. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Detail fabrication and assembly of trapeze hangers.
 - b. Design Calculations: Calculate requirements for designing trapeze hangers.
 - B. Informational Submittals:
 - 1. Welding certificates.
 - C. Closeout Submittals:
 - 1. Operation and Maintenance Data.
- 1.5 QUALITY ASSURANCE
- A. Structural Steel 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. SMACNA.
 - D. Pipe Hanger Standards: Manufacturers Standardization Society (MSS) SP-58, SP-89, and SP-69, as referenced.
 - E. Seismic applications listed within SMACNA that are not usable within a given structure, shall be resolved through engineered adaptations or alteration. Whenever possible these adaptations or alternations shall use SMACNA approved components, to maintain compliance and uniformity with SMACNA's engineering standards and design principles. In all cases, and prior to installation, these adaptations or alternations shall be engineered in accordance with standard engineering practices by a qualified, registered structural engineer, and shall be submitted to project structural engineer and mechanical engineer for their review and approval.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - 1. B-line Systems, Inc; a division of Cooper Industries.
 - 2. Carpenter & Paterson, Inc.
 - 3. ERICO/Michigan Hanger Co.
 - 4. Globe Pipe Hanger Products, Inc.
 - 5. Grinnell Corp.

6. Hilti North America.
7. National Pipe Hanger Corporation.
8. PHD Manufacturing, Inc.

B. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

C. Saddles

1. Material Galvanized Steel, 180-degree shape, each saddle marked with insulation O.D. Standard manufacturers gauge per insulated pipe size.

D. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

E. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

- A.** Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
2. Hanger Rods: Continuous-thread rod, washer, and nuts made of stainless steel.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - a. Unistrut Corporation; Atkore Int.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. Thomas & Betts Corporation.
 - e. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
7. Metallic Coating: Electroplated zinc or Hot-dipped galvanized.
8. Paint Coating: Acrylic.
9. Plastic Coating: PVC.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. ERICO International Corporation.
 - c. PHD Manufacturing, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
7. Coating: **PVC**.

2.5 FIBERGLASS STRUT SYSTEMS

- A. Manufacturers:** Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
1. Power-Strut; Atkore Int.
 2. Champion Fiberglass, Inc.
 3. Cooper B-Line, Inc.
 4. SEASAFE, INC.; a Gibraltar Industries Company.
- B. Description:** Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.
1. Channels: Continuous slotted fiberglass channel with inturned lips.
 2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.6 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO International Corporation.
 - 3. National Pipe Hanger Corporation.
 - 4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 PIPE STANDS

- A. General Requirements for Pipe Stands: 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 integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Plastic or stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.9 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.10 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.11 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-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.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal 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 the building structure.
- B. Metal 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 for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. 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.
- H. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.
- I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic 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.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. 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.
- O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- Q. Insulated Piping:
 - 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 allowed by 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 or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.4 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.

3.5 PAINTING

- A. Touchup: 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 a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are 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 carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers, fiberglass pipe hangers, fiberglass strut systems, and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. 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 non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, 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 36, 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 non-insulated, stationary pipes NPS 1/2 to NPS 8.

8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, 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 or carbon-steel plate.
 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 or carbon-steel plate, 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 two 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 24, 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.
- K. 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 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. 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.
- M. 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.
- N. 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.
- O. 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 allow 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 allow 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 allow 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.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product indicated.
 - 2. Samples: For color, letter style, and graphic representation required for each identification material and device.
 - 3. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
 - 4. Valve numbering scheme.
- B. Closeout Submittal:
 - 1. Valve Schedules: For each piping system to include in maintenance manuals.

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-quarters the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or 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-quarters the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or 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, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number 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) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

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-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or 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; also include 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: Size letters according to ASME A13.1 for piping.

2.4 STENCILS

- A. Stencils for Piping:
 - 1. Lettering Size: Size letters according to ASME A13.1 for piping.
 - 2. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
- B. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
 - 1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
 - 2. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

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, 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. Fasteners: Brass wire-link chain, 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. Description: 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: Safety 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 GENERAL INSTALLATION REQUIREMENTS

- 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.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- B. 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 or 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 and on both side of 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.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
 - 1. Compressed Air Piping:
 - a. Background: Blue.
 - b. Letter Colors: White.

2. Domestic Water Piping
 - a. Background: Green.
 - b. Letter Colors: White.
3. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
4. Fuel Gas Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
5. Laboratory Gas Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

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 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: 1-1/2 inches, round.
 2. Valve-Tag Colors: Natural.
 3. Letter Colors: Black.

3.6 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 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating plumbing piping systems.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing 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 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.
- B. Protection: Do not permit mineral fiber or calcium silicate insulation to get wet. Mineral fiber or calcium silicate insulation that is or has been wet shall be removed from the project site.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields.
- B. Coordinate clearance requirements with piping Installer for piping insulation application.

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 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Non-flexible Fiberglass
 - 1. O-C fiberglass ASJ/SSL-II pipe insulation with all service jacket (ASJ).
 - 2. Thermal conductivity (K value): Not greater than 0.23 at mean temperature of 75 deg F.
 - 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Manville
 - b. Owens Corning Insulating Systems, LLC.
 - c. Manson
 - d. Knauf.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
 - 2. Properties:
 - a. Maximum Operating Temperature: 180 deg F.
 - b. Minimum Operating Temperature: -70 deg F.
 - c. Maximum Thermal Conductivity at 75 deg F Mean Temperature: Thickness 1 Inch or Less: 0.245 Btu-in/hr-ft²-deg F.
 - d. Maximum Water Vapor Permeability Thickness 1 Inch or Less: 0.05 perm-inches.
 - e. Maximum Water Absorption by Volume: 0.2%.

2.2 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.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. 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.

- D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 4. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 - 2. Service Temperature Range: 0 to 180 deg F.
 - 3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 4. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 2. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 4. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 3. Solids Content: 60 percent by volume and 66 percent by weight.
 - 4. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 - 2. Service Temperature Range: 0 to plus 180 deg F.
 - 3. Color: White.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 4. Color: Aluminum.
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.6 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. All-Service Jacket (ASJ): White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I. Maximum water vapor permeance 0.02 perms.
 2. All-Service Jacket – Self-Sealing Lap (ASJ-SSL): ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I. Maximum water vapor permeance 0.02 perms.
 3. Foil-Scrim Kraft (FSK) Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II. Maximum water vapor permeance 0.02 perms.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.8 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

2.9 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. Adhesive as recommended by jacket material manufacturer.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Johns Manville; Ceel-Co or Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Color: White unless indicated otherwise.
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
- D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.
 - b. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.
 2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.
 - b. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.
 - E. Self-Adhesive Indoor or Outdoor Jacket: Multiple-ply laminated vapor barrier and waterproofing membrane for installation over insulation; consisting of aluminum, Tedlar, or laminate sheet with integral acrylic peel-and-stick adhesive with white, silver, or black facing as indicated.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. 3M; VentureClad.
 - b. Polyguard Products, Inc.; Alumaguard 60.
 - F. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - G. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - H. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
- 2.10 PROTECTIVE SHIELDING GUARDS
- A. Protective Shielding Pipe Covers:
 1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
 - B. Protective Shielding Piping Enclosures:
 1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems 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. 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 in accordance with manufacturers' instructions.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system.
- D. Do not install plastic piping in an air plenum.
- E. 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.
- F. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- G. Install multiple layers of insulation with longitudinal and end seams staggered.
- H. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- I. Keep insulation materials dry during application and finishing. Mineral fiber or calcium silicate insulation that is or has been wet shall be removed from the job site.
- J. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- K. Install insulation with least number of joints practical.
- L. 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.
- M. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- N. 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 on center.
 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 on center.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, 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.
- O. Cut insulation in a manner to avoid compressing insulation to less than 75 percent of its nominal thickness.
- P. Repair joint separations and cracking due to thermal movement.
- Q. 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.
- R. 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 firestopping section.
- 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 firestopping section.

3.5 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:
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 more. 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 more. 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 more.
 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 gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. 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.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- 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.

3.7 INSTALLATION OF NON-FLEXIBLE PIPE INSULATION

- A. On piping, install with lap joint attached using outward clinching staples, 3-inch centers, 1/4 inch from edge on hot piping. On cold piping, use self-sealing lap system or adhesive applied to both surfaces per manufacturer's recommendation. Do not staple cold piping. Butt adjoining sections of insulation tightly together and continue jacket by installing self-adhering butt strips over entire circumferential joint.
- B. Installation of Insulation of Fittings
 - 1. For pipe sizes 2 inches and smaller, finish with mineral fiber cement to thickness of adjoining pipe insulation.
 - 2. Over 2 inches, insulate with mitered pipe insulation segments or preformed fiberglass fittings secured with vinyl faced insulation strapping tape or 20 ga galvanized annealed wire and finished with one coat of mineral fiber cement.
 - 3. After cement is dry, finish with Glass Fab and seal with Foster 30-36 adhesive.
 - 4. Prefabricated fitting covers approved for use at pipe fittings may be used instead of finishing method outlined above.
 - 5. Install in accordance with manufacturer's recommendations

3.8 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. 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.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. 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.
- D. 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 on center and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
 - 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 - 2. Wrap factory-presize jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presize jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 - 3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.

4. Jacket can be wrapped along length of roll with 2-inch-overlap seal. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.9 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.
 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 indicated. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 1. NPS 2 or Smaller: Insulation shall be one of the following:
 - a. Fiberglass: 1/2 inches thick
 - b. Flexible Elastomeric: 1/2 inch thick.
 2. NPS 2-1/2 or Larger: Insulation shall be one of the following:
 - a. Fiberglass: 1 inches thick
- B. Domestic Hot and Recirculated Hot Water (105°F - 140°F):
 1. NPS 1-1/4 or Smaller: Insulation shall be one of the following:
 - a. Fiberglass: 1 inches thick
 2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
 - a. Fiberglass: 1-1/2 inches thick
 3. Refer to applicable Energy codes for insulation thicknesses on domestic hot water systems with temperatures higher than 140°F.
- C. Storm Water, Roof Drain, and Overflow Roof Drain (Includes Drain Bodies, excludes Vertical portions of interior storm piping system):
 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Fiberglass: 1 inches thick
 - b. Flexible Elastomeric: 1 inch thick.

- D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be as described in Protective Shielding Guards article above.
- E. Sanitary Waste Piping Where Heat Tracing Is Installed:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Fiberglass: 1 inches thick
- F. Exposed Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Fiberglass: 1 inches thick
 - b. Flexible Elastomeric: 1 inch thick.
- G. Hot Service Drains or Vents:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Fiberglass: 1 inches thick

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 3 inches thick.

3.12 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. Piping, Concealed: None.
- D. Piping, Exposed:
 - 1. PVC, Color-Coded by System: 20 mils thick.
 - 2. Aluminum, Smooth: 0.020 inch thick.
 - 3. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish: 0.016 inch thick.

3.13 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. Piping, Concealed:

1. PVC, Color-Coded by System: 30 mils thick.
2. Aluminum, Smooth: 0.024 inch thick.
3. Stainless Steel, Type 304 or 316, Smooth 2B Finish or Stucco Embossed: 0.016 inch thick.

D. Piping, Exposed:

1. PVC: 30 mils thick.
2. Aluminum, Smooth or Stucco Embossed with Z-Shaped Locking Seam: 0.032 inch thick.
3. Stainless Steel, Type 304 or 316, Smooth 2B Finish or Stucco Embossed with Z-Shaped Locking Seam: 0.020 inch thick.

END OF SECTION 22 07 19

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

1.2 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. Product Data: For grooved-joint couplings and fittings.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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."

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. NSF Compliance:

1. NSF-61 for components in potable water systems.
2. NSF-372 for low-lead requirements.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner's representative no fewer than two days in advance of proposed interruption of water service.

2. Do not interrupt water service without Owner's representative's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 1. MSS SP-123.
 2. Cast-copper-alloy, hexagonal-stock body.
 3. Ball-and-socket, metal-to-metal seating surfaces.
 4. Solder-joint or threaded ends.
- G. Copper Pressure-Seal-Joint Fittings:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Elkhart Products Corporation.
 - b. NIBCO Inc.
 - c. Viega.
 2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
 3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe:
 1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

- B. Standard-Pattern, Mechanical-Joint Fittings:
 - 1. AWWA C110/A21.10, ductile or gray iron.
 - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Compact-Pattern, Mechanical-Joint Fittings:
 - 1. AWWA C153/A21.53, ductile iron.
 - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Push-on-Joint, Ductile-Iron Pipe:
 - 1. AWWA C151/A21.51.
 - 2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
- E. Standard-Pattern, Push-on-Joint Fittings:
 - 1. AWWA C110/A21.10, ductile or gray iron.
 - 2. Gaskets: AWWA C111/A21.11, rubber.
- F. Compact-Pattern, Push-on-Joint Fittings:
 - 1. AWWA C153/A21.53, ductile iron.
 - 2. Gaskets: AWWA C111/A21.11, rubber.
- G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.
- H. Appurtenances for Grooved-End, Ductile-Iron Pipe:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Shurjoint Piping Products.
 - b. Star Pipe Products.
 - c. Victaulic Company.
 - 2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 536, ductile-iron castings with dimensions that match pipe.
 - 3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
 - a. AWWA C606 for ductile-iron-pipe dimensions.
 - b. Ferrous housing sections.
 - c. Butyl-rubber gaskets suitable for hot and cold water.
 - d. ASTM A449 bolts and nuts.
 - e. Minimum Pressure Rating:
 - 1) NPS 3 to NPS 12: 350 psig.
 - 2) NPS 14 to NPS 18: 250 psig.
 - 3) NPS 20 to NPS 46: 150 psig.

2.4 STAINLESS-STEEL PIPING

- A. Potable-water piping and components shall comply with NSF 61.
- B. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 10 and Schedule 40.

- C. Stainless-Steel Pipe Fittings: ASTM A 815/A 815M.
 - D. Appurtenances for Grooved-End, Stainless-Steel Pipe:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Anvil International.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.
 - 2. Fittings for Grooved-End, Stainless-Steel Pipe: Stainless-steel casting with dimensions matching stainless-steel pipe.
 - 3. Mechanical Couplings for Grooved-End, Stainless-Steel Pipe:
 - a. AWWA C606 for stainless-steel-pipe dimensions.
 - b. Stainless-steel housing sections.
 - c. Stainless-steel bolts and nuts.
 - d. EPDM-rubber gaskets suitable for hot and cold water.
 - e. Minimum Pressure Rating: 300 psig.
- 2.5 Pressure-Sealed Fittings and Joints for NPS 2 and Smaller: Cold-drawn, stainless steel with EPDM O-ring seals, suitable for working pressures to 500 psig.
- 2.6 CPVC PIPING
- A. CPVC Pipe: ASTM F 441/F 441M, **Schedule 40 and Schedule 80**.
 - 1. CPVC Socket Fittings: **ASTM F 438 for Schedule 40 and ASTM F 439 for Schedule 80**.
 - 2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
 - B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.
 - C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.
- 2.7 PEX TUBE AND FITTINGS
- A. PEX Distribution System: ASTM F 877, SDR 9 tubing.
 - B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
 - C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.
- 2.8 PEX-AL-PEX TUBE AND FITTINGS
- A. PEX-AL-PEX Distribution System: ASTM F 1281 tubing.
 - B. Fittings for PEX-AL-PEX Tube: ASTM F 1281, metal-insert type with copper or stainless-steel crimp rings and matching PEX-AL-PEX tube dimensions.

2.9 PEX-AL-HDPE TUBE AND FITTINGS

- A. PEX-AL-HDPE Distribution System: ASTM F 1986 tubing.
- B. Fittings for PEX-AL-HDPE Tube: ASTM F 1986, metal-insert type with copper or stainless-steel crimp ring and matching PEX-AL-HDPE tube dimensions

2.10 PP PIPE AND FITTINGS

- A. PP Pipe: ASTM F 2389, SDR 11.

2.11 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
 - 1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Solvent cement and adhesive primer 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."
- G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.12 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: tube.
- C. Color: Black

2.13 TRANSITION FITTINGS

- A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Piping Specialties Products.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc.; a Sensus company.
 - g. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
2. Description:
 - a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket end.

E. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - a. Colonial Engineering, Inc.
 - b. NIBCO Inc.
 - c. Spears Manufacturing Company.
2. Description:
 - a. CPVC four-part union.
 - b. Brass or stainless-steel threaded end.
 - c. Solvent-cement-joint or threaded plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.14 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International.
 - e. Matco-Norca.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.

- c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
 - f. .
- 2. Standard: IAPMO PS 66.
 - 3. Electroplated steel nipple complying with ASTM F 1545.
 - 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 - 5. End Connections: Male threaded or grooved.
 - 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. 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.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground **copper tube and ductile-iron pipe** in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- H. Install domestic water piping level without pitch and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. 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.

- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Do not install plastic piping in an air plenum.
- O. Install piping to permit valve servicing.
- P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- Q. Install piping free of sags and bends.
- R. Install fittings for changes in direction and branch connections.
- S. Install PEX piping with loop at each change of direction of more than 90 degrees.
- T. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- U. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- V. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- W. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. 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.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606 and the manufacturer's published instructions. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts. Grooved-joint coupling manufacturer to provide factory-trained field representative for on-site training for contractor's personnel in proper grooved-joint item fabrication and installation procedures. Representative shall periodically visit job site to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.
- H. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606 and the manufacturer's published instructions. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts. Grooved-joint coupling manufacturer to provide factory-trained field representative for on-site training for contractor's personnel in proper grooved-joint item fabrication and installation procedures. Representative shall periodically visit job site to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.
- I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- J. Joint Construction for Solvent-Cemented Plastic Piping: 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. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- K. Joints for PEX Piping: Join according to ASTM F 1807.
- L. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits or nipples.

- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6: 12 feet with 3/4-inch rod.
 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- J. Install supports for vertical stainless-steel piping every 15 feet.
- K. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
 2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
 3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
 4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 5. NPS 6: 48 inches with 3/4-inch rod.
 6. NPS 8: 48 inches with 7/8-inch rod.
- L. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- M. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.
- N. Install hangers for vertical PEX piping every 48 inches.
- O. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
 2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
 3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
 4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 5. NPS 6: 48 inches with 3/4-inch rod.
 6. NPS 8: 48 inches with 7/8-inch rod.
- P. Install supports for vertical PP piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- Q. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- 3.7 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for 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; extend and connect to the following:
1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.

2. Water Heaters: Cold-water inlet 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 that required by plumbing code.
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 NPS 2-1/2 and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day 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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. 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 a separate report for each test, complete with diagram of portion of piping tested.
 - c. 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.
 - d. 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 it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

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 hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and 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 piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures 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. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- 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 and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. PP, SDR 11 socket fittings; and fusion-welded joints.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.
 - 2. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- E. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.
 - 2. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- F. Aboveground domestic water piping, NPS 2 and smaller shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. CPVC, **Schedule 40 and Schedule 80**; socket fittings; and solvent-cemented joints.
 - 3. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints. **NPS 1-1/2 and NPS 2 CPVC pipe with CPVC socket fittings may be used instead of tubing.**
 - 4. PEX tube, NPS 1 and smaller; fittings for PEX tube; and crimped joints.
 - 5. PEX-AL-PEX tube, NPS 1 and smaller; fittings for PEX-AL-PEX tube; and crimped joints.
 - 6. PP, SDR 11 socket fittings; and fusion-welded joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. CPVC, **Schedule 40 and Schedule 80**; socket fittings; and solvent-cemented.
- H. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. CPVC, **Schedule 40 and Schedule 80**; socket fittings; and solvent-cemented joints.

3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.

2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 22 11 16

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers.
6. Outlet boxes.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water-hammer arresters.
11. Air vents.
12. Trap-seal primer valves.
13. Trap-seal primer systems.
14. Specialty valves.
15. Flexible connectors.
16. Water meters.

1.2 ACTION SUBMITTALS

- A. Product Data:** For each type of product.
- B. Shop Drawings:** For domestic water piping specialties.
1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.**

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:** For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; a division of Watts Water Technologies, Inc.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

- B. Hose-Connection Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Arrowhead Brass Products.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated

- C. Pressure Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: See Drawings Design Flow Rate: See Drawings
6. Selected Unit Flow Range Limits: See Drawings
7. Pressure Loss at Design Flow Rate: See Drawings
8. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1035.
3. Size: NPS 1/4 or NPS 3/8 matching faucet size.
4. Body: Bronze.
5. End Connections: Threaded.
6. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8 or NPS 1/2 or NPS 3/4 or NPS 1.
5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Honeywell International Inc.
 - e. Legend Valve.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2 or NPS 3/4.
5. Body: Bronze.
6. End Connections: Union, solderjoint.
7. Finish: Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: See Drawings
6. Design Flow Rate: See Drawings
7. Selected Unit Flow Range Limits: See Drawings
8. Body: Bronze for NPS 2 and smaller; steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
10. Configuration: Designed for horizontal, straight-throughflow.
11. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Body: Bronze for NPS 2 and smaller; steel with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

D. Beverage-Dispensing-Equipment Backflow Preventers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Body: Stainless steel.
5. End Connections: Threaded.

E. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Ford Meter Box Company, Inc. (The).
 - f. Honeywell International Inc.
 - g. Legend Valve.
 - h. McDonald, A. Y. Mfg. Co.
 - i. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Body: Bronze with union inlet.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Lancer Corporation.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.

4. Body: Stainless steel.
5. End Connections: Threaded.

G. Hose-Connection Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
5. Capacity: At least 3-gpm flow.

H. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Conbraco Industries, Inc.
 - b. FEBCO; a division of Watts Water Technologies, Inc.
 - c. Flomatic Corporation.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 **BALANCING VALVES**

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Corporation; Bell & Gossett Div.
 - d. NIBCO Inc.
 - e. TAC.
 - f. TACO Incorporated.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Type: Ball valve with two readout ports and memory-setting indicator.
3. Body: Brass or bronze.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.

- c. ITT Corporation; Bell & Gossett Div.
 - d. NIBCO Inc.
 - e. TAC.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- 2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
- 3. Size: Same as connected piping, but not smaller than NPS 2-1/2.
- C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- D. Memory-Stop Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO Inc.
 - h. Red-White Valve Corp.
 - 2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 - 3. Pressure Rating: 400-psig minimum CWP.
 - 4. Size: NPS 2 or smaller.
 - 5. Body: Copper alloy.
 - 6. Port: Standard or full port.
 - 7. Ball: Chrome-plated brass.
 - 8. Seats and Seals: Replaceable.
 - 9. End Connections: Solder joint or threaded.
 - 10. Handle: Vinyl-covered steel with memory-setting device.
- E. Automatic Flow-Control Valves for Drinking Water Applications:
 - 1. Description:
 - a. NSF 61-G rated for commercial hot water service temperature up to 180 F.
 - b. NSF 372 lead-free construction.
 - c. Series 300 stainless-steel body.
 - d. All stainless steel wetted parts.
 - e. Tamper-resistant flow cartridge of series 300 stainless steel.
 - f. Basis of Design: Victaulic ICSS Series 76X.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Primary, Thermostatic, Water Mixing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a division of Watts Water Technologies, Inc.
 - e. Symmons Industries, Inc.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: **Exposed-mounted**, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded and union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Rough bronze.
9. Piping Finish: Copper.
10. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

B. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. Honeywell International Inc.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company.
 - f. Powers; a division of Watts Water Technologies, Inc.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Drain: Pipe plug.

2.8 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corporation.
 - d. LSP Products Group, Inc.
 - e. Oatey.
 - f. Plastic Oddities.

- g. Symmons Industries, Inc.
 - h. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
 - j. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
- 2. Mounting: Recessed.
 - 3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
 - 4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.

B. Icemaker Outlet Boxes:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Acorn Engineering Company.
 - b. IPS Corporation.
 - c. LSP Products Group, Inc.
 - d. Oatey.
 - e. Plastic Oddities.
- 2. Mounting: Recessed.
- 3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.

2.9 HOSE BIBBS

A. Hose Bibbs:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Drainage Products.
 - e. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - f. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products
- 2. Standard: ASME A112.18.1 for sediment faucets.
- 3. Include operating key with each operating-key hose bibb.

2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products.
 - g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.

2. Operating Keys(s): Two with each wall hydrant.

B. Nonfreeze, Hot- and Cold-Water Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - a. Josam Company.
 - b. Prier Products, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products.
 - f. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - g. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Vacuum Breaker: Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052. Garden-hose thread complying with ASME B1.20.7 on outlet.
3. Operating Keys(s): Two with each wall hydrant.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Inlet and Vent Outlet End Connections: Threaded.

2.14 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Material: Chrome-plated, cast brass.

2.15 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Precision Plumbing Products, Inc.
2. Standard: ASSE 1044.
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Surface-mounted steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - a. 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.
6. Vacuum Breaker: ASSE 1001.

2.16 SPECIALTY VALVES

A. Comply with requirements for general-duty metal valves in Section 220523 "General-Duty Valves for Plumbing Piping."

B. CPVC Union Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. American Valve, Inc.
 - b. Asahi/America.
 - c. Colonial Engineering, Inc.
 - d. Georg Fischer LLC; GF Piping Systems.
 - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - f. IPEX.
 - g. NIBCO Inc.
 - h. Spears Manufacturing Company.
 - i. Thermoplastic Valves Inc.
2. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating and Temperature: 125 psig.
 - c. Body Material: CPVC.
 - d. Body Design: Union type.
 - e. End Connections for Valves NPS 2 and Smaller: Detachable, socket or threaded.
 - f. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket, threaded or flanged.
 - g. Ball: CPVC; full port.

- h. Seals: PTFE or EPDM-rubber O-rings.
- i. Handle: Tee shaped.

C. PVC Union Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. American Valve, Inc.
 - b. Asahi/America.
 - c. Colonial Engineering, Inc.
 - d. Georg Fischer LLC; GF Piping Systems.
 - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - f. IPEX.
 - g. Jomar International.
 - h. KBI Company.
 - i. Legend Valve.
 - j. McDonald, A. Y. Mfg. Co.
 - k. NIBCO Inc.
 - l. Spears Manufacturing Company.
 - m. Thermoplastic Valves Inc.
2. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating and Temperature: 125 psig.
 - c. Body Material: PVC.
 - d. Body Design: Union type.
 - e. End Connections for Valves NPS 2 and Smaller: Detachable, socket or threaded.
 - f. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket, threaded or flanged.
 - g. Ball: PVC; full port.
 - h. Seals: PTFE or EPDM-rubber O-rings.
 - i. Handle: Tee shaped.

D. CPVC Non-Union Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. American Valve, Inc.
 - b. Asahi/America.
 - c. KBI Company.
 - d. Legend Valve.
 - e. NIBCO Inc.
 - f. Spears Manufacturing Company.
 - g. Thermoplastic Valves Inc.
2. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating and Temperature: 125 psig.
 - c. Body Material: CPVC.
 - d. Body Design: Non-union type.
 - e. End Connections: Socket or threaded.
 - f. Ball: CPVC; full or reduced port.
 - g. Seals: PTFE or EPDM-rubber O-rings.
 - h. Handle: Tee shaped.

E. PVC Non-Union Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. American Valve, Inc.
 - b. Asahi/America.
 - c. Colonial Engineering, Inc.
 - d. Georg Fischer LLC; GF Piping Systems.
 - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - f. IPEX.
 - g. Jomar International.
 - h. KBI Company.
 - i. Legend Valve.
 - j. McDonald, A. Y. Mfg. Co.
 - k. NIBCO Inc.
 - l. Spears Manufacturing Company.
 - m. Thermoplastic Valves Inc.
2. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating and Temperature: 125 psig.
 - c. Body Material: PVC.
 - d. Body Design: Non-union type.
 - e. End Connections: Socket or threaded.
 - f. Ball: PVC; full or reduced port.
 - g. Seals: PTFE or EPDM-rubber O-rings.
 - h. Handle: Tee shaped.

F. CPVC Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Georg Fischer LLC; GF Piping Systems.
 - b. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - c. NIBCO Inc.
 - d. Spears Manufacturing Company.
 - e. Thermoplastic Valves Inc.
2. Description:
 - a. Pressure Rating and Temperature: 125 psig.
 - b. Body Material: CPVC.
 - c. Body Design: Lug or wafer type.
 - d. Seat: EPDM rubber.
 - e. Seals: PTFE or EPDM-rubber O-rings.
 - f. Disc: CPVC.
 - g. Stem: Stainless steel.
 - h. Handle: Lever.

G. PVC Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. American Valve, Inc.
 - b. Asahi/America.
 - c. Colonial Engineering, Inc.
 - d. Georg Fischer LLC; GF Piping Systems.

- e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
- f. IPEX.
- g. Legend Valve.
- h. NIBCO Inc.
- i. Spears Manufacturing Company.
- j. Thermoplastic Valves Inc.

2. Description:

- a. Pressure Rating and Temperature: 125 psig.
- b. Body Material: PVC.
- c. Body Design: Lug or wafer type.
- d. Seat: EPDM rubber.
- e. Seals: PTFE or EPDM-rubber O-rings.
- f. Disc: PVC.
- g. Stem: Stainless steel.
- h. Handle: Lever.

H. CPVC Ball Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

- a. American Valve, Inc.
- b. Asahi/America.
- c. Colonial Engineering, Inc.
- d. Georg Fischer LLC; GF Piping Systems.
- e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
- f. IPEX.
- g. NIBCO Inc.
- h. Spears Manufacturing Company.
- i. Thermoplastic Valves Inc.

2. Description:

- a. Pressure Rating and Temperature: 125 psig.
- b. Body Material: CPVC.
- c. Body Design: Union-type ball check.
- d. End Connections for Valves NPS 2 and Smaller: Detachable, socket or threaded.
- e. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket, threaded or flanged.
- f. Ball: CPVC.
- g. Seals: EPDM- or FKM-rubber O-rings.

I. CPVC Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

- a. Georg Fischer LLC; GF Piping Systems.
- b. Spears Manufacturing Company.

2. Description:

- a. Pressure Rating and Temperature: 125 psig.
- b. Body Material: CPVC.
- c. Body Design: Nonrising stem.
- d. End Connections for Valves NPS 2 and Smaller: Socket or threaded.
- e. End Connections for Valves NPS 2-1/2 to NPS 4: Socket, threaded or Flanged.
- f. Gate and Stem: Plastic.

- g. Seals: EPDM rubber.
- h. Handle: Wheel.

2.17 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - 1. Flex-Hose Co., Inc.
 - 2. Flexicraft Industries.
 - 3. Flex Pression, Ltd.
 - 4. Flex-Weld Incorporated.
 - 5. Hyspan Precision Products, Inc.
 - 6. Mercer Gasket & Shim, Inc.
 - 7. Metraflex, Inc.
 - 8. Proco Products, Inc.
 - 9. TOZEN Corporation.
 - 10. Unaflex.Universal Metal Hose; a Hyspan company.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.18 WATER METERS

- A. Displacement-Type Water Meters:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. AALIAN; a Venture Measurement product line.ABB.Badger Meter, Inc.
 - b. Carlon Meter.
 - c. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - d. Schlumberger Limited; Water Services.
 - e. Sensus.
 - 2. Description:
 - a. Standard: AWWA C700.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: Nutating disc; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility company.
 - e. Case: Bronze.
 - f. End Connections: Threaded.
- B. Turbine-Type Water Meters:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. AALIAN; a Venture Measurement product line.
 - b. ABB.
 - c. Badger Meter, Inc.

- d. Hays Fluid Controls.
 - e. Master Meter, Inc.
 - f. McCrometer, Inc.
 - g. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - h. Schlumberger Limited; Water Services.
 - i. SeaMetrics Inc.
 - j. Sensus.
 - 2. Description:
 - a. Standard: AWWA C701.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: Turbine; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility company.
 - e. Case: Bronze.
 - f. End Connections for Meters NPS 2 and Smaller: Threaded.
 - g. End Connections for Meters NPS 2-1/2 and Larger: Flanged.
- C. Compound-Type Water Meters:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. ABB.
 - b. Badger Meter, Inc.
 - c. Master Meter, Inc.
 - d. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - e. Schlumberger Limited; Water Services.
 - f. Sensus.
 - 2. Description:
 - a. Standard: AWWA C702.
 - b. Pressure Rating: 150-psig working pressure.
 - c. Body Design: With integral mainline and bypass meters; totalization meter.
 - d. Registration: In gallons or cubic feet as required by utility company.
 - e. Case: Bronze.
 - f. Pipe Connections: Flanged.
- D. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.
- E. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. 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 unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each **control valve**.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- I. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- J. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.
- K. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.
- L. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.
- M. Install water-hammer arresters in water piping according to PDI-WH 201.
- N. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- O. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- P. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- Q. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

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. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check, backflow-prevention assemblies.
 - 5. Carbonated-beverage-machine backflow preventers.
 - 6. Dual-check-valve backflow preventers.
 - 7. Water pressure-reducing valves.
 - 8. Calibrated balancing valves.
 - 9. Primary, thermostatic, water mixing valves.
 - 10. Manifold, thermostatic, water mixing-valve assemblies.
 - 11. Photographic-process, thermostatic, water mixing-valve assemblies.
 - 12. Primary water tempering valves.
 - 13. Outlet boxes.
 - 14. Hose stations.
 - 15. Supply-type, trap-seal primer valves.
 - 16. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each **pressure vacuum breaker and reduced-pressure-principle backflow preventer** according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 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.

END OF SECTION 22 11 19

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.

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. Waste, Force-Main Piping: 50 psig.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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."

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste 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 requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Extra Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Ideal Tridon
 - g. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.
- B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- C. Steel Pipe Pressure Fittings:
 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Cast-Iron Flanges: ASME B16.1, Class 125.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.5 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.
- D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
- E. Copper Pressure Fittings:
 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.6 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
 - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer 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."
- D. Solvent Cement: ASTM D 2564.
 - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Solvent cement 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."

2.7 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
 - 4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5. Pressure Transition Couplings:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Dresser, Inc.
 - 3) EBAA Iron, Inc.
 - 4) JCM Industries, Inc.
 - 5) Romac Industries, Inc.
 - 6) Smith-Blair, Inc.; a Sensus company.
 - 7) The Ford Meter Box Company, Inc.
 - 8) Viking Johnson.
- b. Standard: AWWA C219.
- c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: **Carbon steel**.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Hart Industries International, Inc.
 - 4) Jomar International Ltd.
 - 5) Matco-Norca, Inc.
 - 6) McDonald, A. Y. Mfg. Co.
 - 7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 8) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
- 3. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Matco-Norca, Inc.
 - 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 5) Wilkins; a Zurn company.
 - b. Description:

- 1) Standard: ASSE 1079.
- 2) Factory-fabricated, bolted, companion-flange assembly.
- 3) Pressure Rating: 125 psig minimum at 180 deg F.
- 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Advance Products & Systems, Inc.
- 2) Calpico, Inc.
- 3) Central Plastics Company.
- 4) Pipeline Seal and Insulator, Inc.

b. Description:

- 1) Nonconducting materials for field assembly of companion flanges.
- 2) Pressure Rating: 150 psig.
- 3) Gasket: Neoprene or phenolic.
- 4) Bolt Sleeves: Phenolic or polyethylene.
- 5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Elster Perfection.
- 2) Grinnell Mechanical Products.
- 3) Matco-Norca, Inc.
- 4) Precision Plumbing Products, Inc.
- 5) Victaulic Company.

b. Description:

- 1) Standard: IAPMO PS 66
- 2) Electroplated steel nipple.
- 3) Pressure Rating: 300 psig at 225 deg F.
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

2.8 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: tube.
- D. Color: Black.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. 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.
- 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. Do not install plastic piping in an air plenum.
- 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. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- L. 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 two 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.
- M. 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.
- N. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 1 percent downward in direction of flow.

- 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
 - O. 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."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
 - P. Install steel piping according to applicable plumbing code.
 - Q. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
 - R. Install aboveground PVC piping according to ASTM D 2665.
 - S. Install underground PVC piping according to ASTM D 2321.
 - T. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
 - U. Install force mains at elevations indicated.
 - V. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - W. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- 3.3 JOINT CONSTRUCTION
- A. 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.
 - B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
 - C. 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.
- D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- E. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- F. Plastic, Nonpressure-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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in OD's.
 2. In Drainage Piping: Shielded, nonpressure transition couplings.
 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
 3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
 4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
1. Install shutoff valve on each sewage pump discharge.
 2. Install gate or full-port ball valve for piping NPS 2 and smaller.
 3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
1. Horizontal Piping: Horizontal backwater valves.
 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 3. Install backwater valves in accessible locations.

4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install **stainless-steel or fiberglass** pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, **valve**, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 2. NPS 3: 60 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
 8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.

- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
 - 5. NPS 6: 10 feet with 5/8-inch rod.
 - 6. NPS 8: 10 feet with 3/4-inch rod.
- K. Install supports for vertical copper tubing every 10 feet.
- L. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
- M. Install supports for vertical PVC piping every 48 inches.
- N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 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.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Install horizontal backwater valves in pit with pit cover flush with floor.
 - 6. Comply with requirements for **backwater valves**, cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
 - 1. Sanitary Sewer: To exterior force main.
 - 2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the 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.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

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 AND PROTECTION

- 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.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil, waste and vent piping NPS 4 and smaller shall be one of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be one of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings CISPI heavy-duty hubless-piping couplings; and coupled joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be one of the following:
 1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Underground, soil and waste piping NPS 5 and larger shall be one of the following:
 1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be the following:
 1. Galvanized-steel pipe, pressure fittings, and threaded joints.
- G. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be the following:
 1. Galvanized-steel pipe, pressure fittings, and threaded joints.

END OF SECTION 22 13 16

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trap-seal primer devices – Barrier type
5. Air-admittance valves.
6. Roof flashing assemblies.
7. Through-penetration firestop assemblies.
8. Miscellaneous sanitary drainage piping specialties.
9. Flashing materials.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
1. FOG disposal systems.
 2. Grease interceptors.
 3. Grease removal devices.
 4. Oil interceptors.
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- 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 NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements.
- B. Coordinate size and location of roof penetrations.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- 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. Cultures: Provide 1-gal. bottles of bacteria culture recommended by manufacturer of FOG disposal systems equal to 200 percent of amount installed, but no fewer than 2 1-gal. bottles.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.14.1.
 - 3. Size: Same as connected piping.

4. Body: Cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: Hub and spigot or hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Horizontal, Plastic Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
 - f. Sioux Chief Manufacturing Company, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
2. Size: Same as connected piping.
3. Body: PVC.
4. Cover: Same material as body with threaded access to check valve.
5. Check Valve: Removable swing check.
6. End Connections: Socket type.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.
 - 2) MIFAB, Inc.
 - 3) Smith, Jay R. Mfg. Co.
 - 4) Tyler Pipe.
 - 5) Watts Drainage Products.
 - 6) Zurn Plumbing Products Group.
2. ASME A112.3.1, Stainless-Steel Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.
3. Standard: **ASME A112.36.2M for cast iron, ASME A112.3.1 for stainless steel** for cleanout test tee.
4. Size: Same as connected drainage piping
5. Body Material: As required to match connected piping.
6. Closure: Countersunk or raised-head, brass plug.
7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
8. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.
 - 2) Oatey.
 - 3) Sioux Chief Manufacturing Co., Inc.
 - 4) Smith, Jay R. Mfg. Co.
 - 5) Tyler Pipe.
 - 6) Watts Drainage Products.
 - 7) Zurn Plumbing Products Group.
- 2. ASME A112.36.2M, Stainless-Steel Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.
 - 2) Kusel Equipment Co.
 - 3) Smith, Jay R. Mfg. Co.
 - 3. Standard: ASME A112.36.2M.
- C. Cast-Iron Wall Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M. Include wall access.
 - 3. Size: Same as connected drainage piping.
 - 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
 - 6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
 - 7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.
- D. Plastic Floor Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities.
 - e. Sioux Chief Manufacturing Company, Inc.
 - 2. Body: PVC.
 - 3. Closure Plug: PVC.
 - 4. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.3 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Commercial Enameling Co.
- b. Josam Company; Josam Div.
- c. MIFAB, Inc.
- d. Prier Products, Inc.
- e. Smith, Jay R. Mfg. Co.
- f. Tyler Pipe; Wade Div.
- g. Watts Drainage Products.
- h. Zurn Plumbing Products Group.

- 2. Standard: ASME A112.6.3.

B. Stainless-Steel Floor Drains:

- 1. ASME A112.6.3, Stainless-Steel Floor Drains:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Josam Company.
 - 2) Kusel Equipment Co.
 - 3) Scherping Systems, Inc.
 - 4) Smith, Jay R. Mfg. Co.
 - 5) Tyler Pipe.
 - 6) Watts Drainage Products.
 - 7) Zurn Plumbing Products Group.

C. Plastic Floor Drains:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. Josam Company; Josam Div.
 - d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
 - f. Sioux Chief Manufacturing Company, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.

- 2. Standard: ASME A112.6.3.

2.4 TRAP-SEAL PRIMER DEVICE – BARRIER TYPE

A. Barrier-Type, Trap-Seal Primer Device:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. SureSeal, Division of Rectorseal, LLC
- 2. Standard: ASSE 1072, one piece barrier type floor drain trap seal protection device provided full size of the piping trap connection it serves.
- 3. Material: Chrome-plated, cast brass.

2.5 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
2. Description: Manufactured assembly of flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ProSet Systems Inc.
 2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
 3. Size: Same as connected soil, waste, or vent stack.
 4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 6. Special Coating: Corrosion resistant on interior of fittings.

2.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
- B. Floor-Drain, Trap-Seal Primer Fittings:
 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
- C. Air-Gap Fittings:
 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
- D. Sleeve Flashing Device:
 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.

E. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.

F. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.

G. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

H. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.

2.8 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft..
2. Vent Pipe Flashing: 8 oz./sq. ft..

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, 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 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 NPS 4. Use NPS 4 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 NPS 4 and smaller and 100 feet for larger 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 at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- G. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- H. Assemble open drain fittings and install with top of hub 2 inches above floor.
- I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- 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 vent caps on each vent pipe passing through roof.
- M. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- O. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- P. Install wood-blocking reinforcement for wall-mounting-type specialties.

- Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- R. Do not install plastic piping in an air plenum.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 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. Copper Sheets: Solder joints of copper sheets.
- 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.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:

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.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

SECTION 22 33 00

ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Commercial, electric, storage, domestic-water heaters.
 - 2. Commercial, light-duty, storage, electric, domestic-water heaters.
 - 3. Domestic-water heater accessories.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Certificates: For each type of commercial and tankless, electric, domestic-water heater, from manufacturer.
- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- D. Source quality-control reports.

- E. Field quality-control reports.
- F. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water 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, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
- 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: Three years.
 - b. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1) Storage Tank: Three years.
 - 2) Controls and Other Components: Two years.

- c. Electric, Tankless, Domestic-Water Heaters: One year(s).
- d. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bradford White
 - b. Lochinvar
 - c. Rheem
 - d. A.O. Smith, State.
2. Standard: UL 1453.
3. Storage-Tank Construction: ASME-code, steel horizontal arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
4. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1.
 - d. Jacket: Steel with enameled finish.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amtrol
 - b. A.O. Smith
 - c. Taco, State.

2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 3. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
 - B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
 - C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
 - D. Heat-Trap Fittings: ASHRAE 90.2.
 - E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- maximum outlet pressure unless otherwise indicated.
 - F. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
 - G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
 - H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
 - I. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
 - J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
 - K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.
 - L. Recirculating Pumps: In-line all-bronze pump with gauge ports at nozzles and with vent and drain ports. Mechanical seal with ceramic seat and carbon seal ring suitable for continuous operation at 225 deg F. Built-in overload protection. 1750 rpm, drip-proof-type motor, maximum rating of working pressure up to 175 psi
 1. Manufacturers: Bell & Gossett, Grundfos, TACO, Amtrol
 - M. Aquastats: Thermostat for controlling pump based on water temperature. Strap-on or insertion bulb type.
- 2.3 SOURCE QUALITY CONTROL
- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
 - B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases.
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. 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 concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- C. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- G. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

- H. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig . Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."
- I. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- J. Fill electric, domestic-water heaters with water.
- K. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 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.
 - 2. Leak Test: After installation, charge system 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 operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain **commercial**, electric, domestic-water heaters.

END OF SECTION 22 33 00

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work of this Section includes, but is not limited to:
 - 1. Inclusion of all plumbing fixtures, complete and ready for use. All fixtures, except as otherwise specified, shall be constructed of vitreous china with all visible exposed surfaces glazed.
 - 2. Providing all stops, traps, escutcheons, connections, etc., as are necessary to complete the installation of each fixture, whether such items are listed or not.
 - 3. Plumbing Trim: All finished exposed faucets, traps, connecting piping, stops, flush valves and other fixture trim shall be chromium-plated brass unless otherwise specified and shall be supported rigidly to fixtures and to walls with matching brackets at not more than 2'-0" center. All fastenings shall be chromium-plated brass or may be 302 stainless steel if of matching color and finish. Faucets shall be furnished as required. Vacuum breakers shall be provided as a part of the fixture trim wherever there is a possibility of back-siphoning.
 - 4. Fixture Stops: Shut-offs for urinal and water closet flush valves shall be an integral part of the fixture or fitting; shut-offs for all other fixtures shall be loose-key, lock-shield-type. All fixture stops shall be angle- or straight-type adapted for each particular location and shall be located immediately adjacent to the fixture. Use threaded adaptors when used in conjunction with copper tube work.
 - 5. All exposed screws or fasteners for plumbing fixtures and faucets shall be vandalproof. Contractor shall take care to coordinate this item with his suppliers prior to Shop Drawings submittal.
 - 6. Aerators, where required for sinks and lavatories shall be vandalproof

1.2 QUALITY ASSURANCE

- A. Meet the requirements of the following:
 - 1. State Plumbing Code.
 - 2. State Department of Housing, Buildings and Construction.
- B. Material Standards
 - 1. ANSI/ASME A112.19.2-90: Vitreous China Plumbing Fixtures.
 - 2. ANSI/ASME A112.19.3-87: Stainless Steel Plumbing Fixtures (Designed for Residential Use).
 - 3. ANSI/ASME A112.19.5-79: Trim for Water Closet Bowls, Tanks, and Urinals.
 - 4. ANSI/ASSE 1016-90: Performance Requirements for Thermostatic, Pressure Balancing and Combination Control Valves for Bathing Facilities.
- C. ANSI/ASSE 1025-78: Performance Requirements for Diverters for Plumbing Faucets with Hose Spray, Anti-Siphon-Type, Residential Applications.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fixtures.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.
- C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. For flushometer valves and electronic sensors to include in operation and maintenance manuals.
 - 2. For lavatories and faucets to include in operation and maintenance manuals.
 - a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following: Servicing and adjustments of automatic faucets.
 - 3. For sinks to include in maintenance manuals.
 - 4. For shower faucets to include in maintenance manuals.
 - 5. For wash fountains and components to include in operation and maintenance manuals.
 - 6. For drinking fountains to include in maintenance manuals.
 - 7. For remote water coolers to include in maintenance manuals.
 - 8. For pressure water coolers to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no less than one of each type.
 - 2. Waterless Urinal Trap-Seal Cartridges: Equal to 200 percent of amount of each type installed, but no fewer than 12 of each type.
 - 3. Waterless Urinal Trap-Seal Liquid: Equal to 1 gallon for each urinal installed.
 - 4. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 - 5. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
 - 6. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no less than 1 of each.

PART 2 - PRODUCTS

2.1 MATERIALS - GENERAL

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Plumbing Faucets: Chicago Faucet, American Standard, Kohler, Symmons, Speakman, and Moen.
 - 2. Flush Valves: Sloan, Moen and Zurn.
 - 3. Vitreous China Plumbing Fixtures: American Standard, Kohler, Gerber.
 - 4. Service Basins: Fiat, Stern and Williams, Mustee, Zurn and Creative Industries.
 - 5. Service Sinks: American Standard, Kohler, Gerber.
 - 6. Utility Sinks: Fiat, Stern and Williams, Mustee.
 - 7. Stainless Steel Utility Sinks: Advanced Tabco, Elkay, Just.
 - 8. Closet Seats: Church, Sperzel, Bemis, Beneke, and Centoco.
 - 9. Shower Mixing Valves: Powers, Leonard, Lawler, and Bradley.
 - 10. Stainless Steel Sinks: Elkay, Just, Metcraft, and Southern Kitchens.
 - 11. Electric Water Coolers: Elkay, Haws, Oasis, and Halsey-Taylor.
 - 12. Precast Shower Receptacles: Fiat, Stern and Williams, Creative Industries.
 - 13. Prefabricated Showers and Tubs: Fiat, Kohler, Aquaglass, Aquatic.
 - 14. Laundry Tubs: Fiat, Stern/Williams, Mustee.
 - 15. Lavatory Systems: Bradley, Acorn, Intersan.

- 16. Carriers: Josam, Smith, Wade, Watts, Zurn or Mifab.
- B. Plumbing Fixtures – General: Constructed or equipped with anti-siphon devices to prevent siphoning waste material into potable water supply system.
- C. Escutcheons and Plates: Conceal all holes where pipes pass through walls, floors or ceilings; use plates or escutcheons.
- D. Piping Exposed in Finished Areas (including fittings and trim): Chromium-plated or nickel-plated brass with polished bright surface.
- E. Trim for Lavatories and Sinks: Provide with renewable cartridges.
- F. Vitreous Caps: Provide for water closet bolts.
- G. Sealant: Silicone-type. See Division 07 Section “Joint Sealants”.

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 water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Water-Closet
 - 1. Installation:
 - a. Install level and plumb according to roughing-in drawings.
 - b. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
 - c. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
 - 2. Support Installation:
 - a. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
 - b. Use carrier supports with waste-fitting assembly and seal.
 - c. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
 - d. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
 - 3. Flushometer-Valve Installation:
 - a. Install flushometer-valve, water-supply fitting on each supply to each water closet.
 - b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
 - c. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
 - d. Install actuators in locations that are easy for people with disabilities to reach.
 - e. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
 - 4. Install toilet seats on water closets.
- B. Urinal
 - 1. Installation:

- a. Install urinals level and plumb according to roughing-in drawings.
 - b. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
 - c. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
 - d. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
 - e. Install trap-seal liquid in waterless urinals.
 2. Support Installation:
 - a. Install supports, affixed to building substrate, for wall-hung urinals.
 - b. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
 - c. Use carriers without waste fitting for urinals with tubular waste piping.
 - d. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
 3. Flushometer-Valve Installation:
 - a. Install flushometer-valve water-supply fitting on each supply to each urinal.
 - b. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
 - c. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
 - d. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- C. Lavatories
 1. Install lavatories level and plumb according to roughing-in drawings.
 2. Install supports, affixed to building substrate, for wall-mounted lavatories.
 - a. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
 3. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
 4. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
 5. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- D. Sinks
 1. Install sinks level and plumb according to roughing-in drawings.
 2. Install supports, affixed to building substrate, for wall-hung sinks.
 - a. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
 3. Set floor-mounted sinks in leveling bed of cement grout.
 4. Install water-supply piping with stop on each supply to each sink faucet.
 - a. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
 - b. Install stops in locations where they can be easily reached for operation.
 5. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
 6. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."
- E. Showers
 1. Assemble shower components according to manufacturers' written instructions.
 2. Install showers level and plumb according to roughing-in drawings.
 3. Install water-supply piping with stop on each supply to each shower faucet.
 - a. Exception: Use ball, gate, or globe valves if supply stops are not specified with shower. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
 - b. Install stops in locations where they can be easily reached for operation.
 4. Install shower flow-control fittings with specified maximum flow rates in shower arms.
 5. Set shower receptors or shower basins in leveling bed of cement grout.

6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Wash Fountains

1. Install wash fountains level and plumb according to roughing-in drawings.
2. Set freestanding wash fountains on floor.
3. Install off-floor carrier supports, affixed to building substrate, for wall-mounted wash fountains.
4. Install accessible, wall-mounted wash fountains at mounting height for handicapped/elderly according to ICC A117.1.
5. Install water-supply piping with shutoff valve on each supply to each wash fountain to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
6. Install trap and waste piping on each drain outlet of each wash fountain to be connected to sanitary drainage system.
7. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Electric Water Coolers

1. Install electric water cooler level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
2. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
3. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.
4. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
5. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants." "Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

I. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixture with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to fixtures, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust fixture and controls. Replace damaged and malfunctioning fixture
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. Clean fixture and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 40 00

SECTION 23 05 00

HVAC GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
 - 1. General requirements applicable to all HVAC work.
 - 2. Submittal process.
 - 3. Requests for information/interpretation (RFIs)
 - 4. Coordination and fabrication drawings.
 - 5. Operation and maintenance manuals.
 - 6. As-built and record drawings.
 - 7. Maintenance materials, spare parts, and filters.
 - 8. Access doors and panels.
 - 9. Owner training.

1.2 SUBMITTALS

- A. Action submittals:
 - 1. Coordination and fabrication drawings.
- B. Informational submittals:
 - 1. Proposed equipment and material list.
 - 2. List of service providers for all proposed equipment.
 - 3. Construction schedule.
 - 4. Substantial completion maintenance requirements.
 - 5. System and equipment start-up reports/checklists.
- C. Closeout submittals:
 - 1. Operation and maintenance manuals.
 - 2. As-built drawings.

1.3 WORK INCLUDED

- A. Contractor shall comply with the entire set of construction documents (drawings and specifications) for all divisions/trades. Contractor shall pay close attention to additional requirements that may be listed in the general conditions on the architectural drawings and in the Division 01 front-end specifications. It is the contractor's responsibility prior to bids to review all construction documents.
- B. Carefully examine the construction documents, visit the site, and thoroughly become familiar with the local conditions relating to the work. Failure to do so will not relieve the contractor of any obligations of the contract.
- C. In case of clarifications or discrepancies, the contractor shall promptly notify the Architect/Engineer (A/E) in writing for final determination prior to the bid. If determination from the A/E is not provided, the contractor shall include the highest cost option in their bid price.
- D. Provide all materials, equipment, fees, and permits to perform all the labor required to install complete and operable systems as stated, implied, or intended in the drawings and specifications. Include in the bid as

part of the contract, all necessary and applicable supplies, materials, and appurtenances, whether indicated or not.

- E. The drawings show the principal engineering design elements of the mechanical installation. They are not intended to be detailed construction installation drawings for the mechanical work but as a complement to the specifications to clarify the principal features of the mechanical systems. It is the intent of this section that all equipment and devices, furnished and installed under this and other sections, be properly connected and interconnected with other equipment to render the installation complete for successful operation, regardless of whether all the connections and interconnections are specifically mentioned in the contract specifications or shown on the contract drawings.
- F. Check the layout and routing as indicated on the drawings for all HVAC work. Determine exact locations and layouts using the dimensions of the equipment approved. Obtain written approval from the A/E for any revised layout before equipment or material involved is installed. Consult the architectural and structural drawings for all dimensions, locations, and sizes of structure, structural supports, foundations, ceiling heights, door swings, and other detail information required for a correct installation of this work.
- G. Examine all other divisions/trades of the contract documents for work related to the work of this division/trade. Cooperate to provide continuity of work, to eliminate duplications, and to provide mechanical work in support of such related work. Furnish to other trades and on schedule all information required for the execution of mechanical work.
- H. Any additional work such as cutting, drilling, patching, excavations, moving of another trade's work because of delay in mechanical work, lack of information, or lack of coordination is a part of this division/trade and shall be performed without additional cost to others.
- I. Install and connect devices and equipment in accordance with the best engineering practice and the manufacturer's instructions and recommendations. Provide all incidental ductwork, piping, valves, connections, and all similar material recommended by the manufacturer, or required for proper operation and maintenance without additional cost to others.
- J. All control wiring associated with the mechanical systems shall be provided by this division/trade. All wiring shall comply with Division 26 standards.

1.4 SPECIFIED ELSEWHERE

- A. The following will be provided by other divisions/trades:
 - 1. Openings: Walls, floor, ceiling and roof openings specifically shown and identified on the architectural/structural drawings will be provided by those associated divisions/trades. Openings not identified that are required for mechanical work, or changes to such openings, are part of the work of this mechanical division/trade.
 - 2. Roof penetrations: Curbs, drains, sleeves, and other roof penetrations under this division/trade shall be incorporated into the finished roofing and made watertight under another division/trade, unless otherwise specified.
 - 3. Equipment bases: Coordinate and furnish dimensions, sleeves, inserts, hold-down bolts, and templates for their installation. Supervise their installation. Concrete equipment bases, mounting slabs, and housekeeping pads not shown on the structural drawings shall be provided under this division/trade.
 - 4. Painting: Painting of all exposed-to-view pipes, ducts, hangers, supports, equipment, etc. shall be performed under another division/trade. This division/trade is responsible for making all HVAC exposed-to-view items paint ready. Under this division/trade, all manufactured equipment shall be furnished with factory-finished baked enamel, unless otherwise specified.
 - 5. Power wiring: All power wiring associated with equipment provided under this division/trade shall be furnished, installed, and wired in accordance with Division 26. Under this division/trade, provide installation instructions, locating dimensions, and wiring diagrams for the other divisions/trades. Supervise the installation.

1.5 DEFINITIONS

- A. Provide: Furnish, install, and connect complete so that the particular item referred to is ready for operation/use.
- B. Furnish: To purchase, procure, acquire, and deliver complete with related accessories.
- C. Install: To erect, mount, and connect complete so that the particular item referred to is ready for operation/use.
- D. Work: Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.
- E. Concealed: Work installed out of sight in spaces. Embedded in masonry or other construction, or installed in furred spaces, above ceilings, in trenches, in crawl spaces, or in enclosures.
- F. Exposed: Work installed in view in spaces. Not installed underground, above a ceiling, or concealed as defined above.
- G. Interior: Inside the thermal barrier of the building. Not subject to outdoor ambient temperatures and conditions.
- H. Exterior: Outside of the thermal barrier of the building. Subject to outdoor ambient temperatures and conditions.
- I. Accessible: Capable of being reached, used, adjusted, removed, and maintained without removal of other non-operable items.

1.6 CODES AND STANDARDS

- A. All work shall be performed in accordance and comply with all laws, regulations, insurance carrier requirements, codes, and standards (federal, state, and local) as adopted by the authorities having jurisdiction, where any differ, the most stringent shall apply. Nothing in the construction documents shall be construed to permit deviation from the governing laws, regulations, insurance carrier requirements, codes, and standards (federal, state, and local).
- B. Applicable publications: Reference made to codes and standards refer to the latest edition including all addenda/revisions existing on the date of execution of the contract, unless noted otherwise.

1.7 BIDDING

- A. Design alternates (if applicable): Contractors are to state, within the forms of their bid proposals, the total labor and material price (including mark-ups) to be added to or deducted from the base bid amount for each of the alternates indicated herein or within the bid form or instructions to bidders, that the owner may or may not decide to accept.
- B. Unit pricing (if applicable): Contractors are to state, within the forms of their bid proposals, the total labor and material unit price (including mark-ups) to be added to or deducted from the base bid amount on a unit-by-unit basis during the construction period of the project, that takes place before final inspection or date of acceptance review. Unit costs shall include all work required, including controls, wiring, and interlocks, to install complete and operable systems. See bid form or instruction to bidders regarding these unit cost items.

1.8 DIVISION OF WORK

- A. The A/E does not define the scope of individual divisions/trades, subcontractors, equipment manufacturers, material suppliers, and vendors. Any sheet numbering or specification numbering system used which identifies disciplines is solely for the A/E's convenience and is not intended to define a subcontractor's scope of work. Information regarding individual trades, subcontractors, material suppliers and vendors may be detailed, described, and indicated at different locations throughout the contract documents. No consideration will be given to requests for change orders for failure to obtain and review the complete set of construction documents when preparing bids, prices, and quotations. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be the responsibility of the contractor holding the prime contract.

1.9 PERMITS AND INSPECTIONS

- A. Obtain and pay for all permits, bonds, licenses, fees, etc. required by the federal, state, and local authority having jurisdiction over the work.
- B. Arrange and pay for inspections required by the federal, state, and local authority having jurisdiction. Conceal no work until approved by these governing authorities. Provide properly signed certificates of final inspection to owner prior to owner's final acceptance of the work.
- C. Obtain and pay for all meters, instruments, devices, etc. required for permits and inspections.

1.10 QUALITY ASSURANCE

- A. HVAC systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes and standards.
- B. The mechanical contractor must have documented experience on at least two building projects with a similar scope of work within the last 5 years. The mechanical contractor must have sufficient general knowledge and experience to anticipate the needs for construction of this nature.
- C. All mechanical contractors and personnel shall be experienced and qualified specialists in HVAC and all work must be properly supervised.
- D. All materials furnished shall be new and shall comply with all applicable standards. All materials or work found to be defective, damaged, or not in strict conformity with the construction documents shall be rejected and shall be removed and replaced by the contractor at no additional cost to the owner. Contractor is responsible for any damage caused by them to other contractor's work.
- E. Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design, and workmanship. Standard products must have been in satisfactory commercial or industrial use for at least two years, unless noted otherwise. This timeframe of use must include applications of equipment and materials under similar circumstances and of similar size.
- F. All equipment must be supported by service providers or service direct from the manufacturer. See individual equipment specification sections for further requirements. Service providers shall be authorized and trained by the manufacturers of the equipment supplied. These service providers must be reasonably convenient (within 2 hour drive) to the equipment installation location and able to render satisfactory service to the equipment on a regular and emergency basis. Contractor must submit to the A/E a list of service providers for all their proposed equipment prior to any equipment or material submittals. This list shall include the name of the service provider, address, the distance from the jobsite, phone number, and email address.
- G. Contractor shall visit the site of the work to gain an acceptable knowledge of conditions affecting the execution of the work. After visiting the site, request information and/or clarifications as necessary to fully understand the work required and to properly estimate costs.

- H. All welding personnel shall be certified by the American Welding Society (AWS). All welding shall comply with the associated latest version of the ANSI/AWS code.

1.11 SUBMITTAL PROCESS

- A. Contractor shall submit under provisions of Division 01 and as specified within this section. The most stringent requirements shall apply.
- B. Part 1 of each specification section of the construction documents lists the associated submittals that are required to be submitted to the A/E. The contractor must submit one combined submittal per specification section that includes all materials and equipment that are required to be submitted per that associated section. The A/E will not review piecemeal submittals or submittals that are grouped together with an item from a different specification section, and if submitted they will be processed as "does not conform." The contractor must clearly indicate for each item submitted the specification section/sub-section number.
- C. Within 45 calendar days after date of contract agreement and prior to any other submittals, the contractor shall submit to the A/E a list of all items of equipment and material proposed for installation on this project. This list must include all equipment and materials that require a submittal. Provide the specification section/sub-section number, manufacturer's name, manufacturer representative, model number, size, and any other information required to identify each item.
- D. Definitions:
 - 1. Action submittal: Written information that requires the A/E's responsive action. Materials and equipment submitted shall meet all the requirements of the construction documents. No materials or equipment shall be ordered until the submittal has been reviewed and processed as "reviewed for compliance" or "conforms as noted."
 - 2. Informational submittal: Written information that does not require the A/E's review or processing. This information is submitted for record purposes only. It is the contractor's responsibility to make sure materials and equipment comply with the construction documents prior to ordering. If the A/E or others choose to review, the submittal may be rejected for non-compliance with the construction documents.
 - 3. Closeout submittal: Written information required at the end of construction in order for final owner acceptance and project closeout. This information requires the A/E's responsive action to verify the required information was provided.
 - 4. Reviewed for compliance: The submittal was reviewed for compliance by the A/E and the submittal was found to generally conform with the design concept and construction documents.
 - 5. Conforms as noted: The submittal was reviewed for compliance by the A/E and the submittal was found to generally conform with the design concept and construction documents with exception to the item(s) noted. The item(s) noted by the A/E must be changed and/or included, however, the submittal should not be resubmitted.
 - 6. Revise and resubmit: The submittal was reviewed for compliance by the A/E and the submittal did not conform with the design concept and construction documents. The items noted by the A/E must be changed or included and the submittal must be resubmitted.
 - 7. Does not conform: The submittal was reviewed for compliance by the A/E and the submittal did not conform with the design concept and construction documents. The items noted by the A/E must be corrected and a new submittal is required.
- E. Submittals reviewed by the A/E shall not take precedence over the construction documents. The review of submittals by the A/E does not relieve the contractor from their responsibility to comply with the construction documents nor does it authorize any additional cost. The contractor remains responsible for complying with all information shown on the construction documents including performance data, electrical characteristics, dimensional data including required clearances, features, specified options, details, quantities, and for all coordination of the work with all other trades. A/E review is not to be construed as a complete check of every requirement in the construction documents.
- F. Submittals shall identify the manufacturer, specific model number, performance data, electrical characteristics, dimensional data including required clearances, features, specified options, wiring diagrams, warranty information, and any other information necessary to determine if the product or equipment

conforms with the construction documents. The contractor shall submit only material applicable for the project, shall identify the specific items, and shall clearly indicate all options that apply.

- G. Unless noted otherwise, when two or more units of materials or equipment of the same type or class are required, these units shall be of the same manufacturer and model number, or if different models are required, they shall be of the same manufacturer and identical to the greatest extent possible (example: same model series).
- H. Although basis of design models and manufacturers are indicated in the construction documents, it is the responsibility of the manufacturers to verify the model selections so that the equipment complies with all listed requirements of the construction documents. If issues are found, the contractor shall inform the A/E for direction.
- I. All submittals shall bear the contractor's certification that they have reviewed, checked, and approved the submittal, that they have been coordinated with the requirements of the project and the provisions of the construction documents, and that they have verified all field measurements and construction criteria, materials, catalog numbers, and similar data. Submittals without a contractor approval will not be reviewed and will be processed as "does not conform."
- J. Submittals shall not contain conflicting information. If a submittal is found to be conflicting, the submittal will be processed without further review as "does not conform." If a submittal is processed as "reviewed for compliance" or "conforms as noted" and conflicting information is found after the fact, it is the contractor's responsibility to correct all items so all material and equipment complies with the construction documents at no cost to the owner.
- K. Items that are submitted but are not required to be submitted by part 1 of the associated specification section, will not be reviewed and will be returned as "does not conform" noting the issue.
- L. Contractor shall submit electronic files of all submittals as a single PDF file per specification section. File size shall be less than 20MB and the file shall be named starting with the specification number and end with the submittal revision number. Electronic submittals shall be emailed to submittals@aecmep.com and the AEC project manager. Include in the subject of the email the project name as listed on contract and the specification section number. Other means of file transmission such as FTP or through construction management software websites shall be mutually agreed upon. Contractor must provide a title page for each submittal containing the following information:
 - 1. Project name as listed on contract.
 - 2. Project location.
 - 3. Specification section number and title.
 - 4. Material or equipment specified.
 - 5. Date.
 - 6. Submittal revision number.
 - 7. Name of contractor and individual with contact information.
 - 8. Name of firm and individual with contact information for entity that prepared the submittal.
- M. Electronic copies of the construction documents are available from the A/E for contractor's use in preparing submittals. Revit models shall be in the version in which they are created.
- N. Do not purchase material/equipment, begin fabrication, or start work that requires an action submittal until the submittal is processed as "reviewed for compliance" or "conforms as noted" by the A/E.
- O. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow time for long lead equipment and potential resubmittals. No delay cost or time extensions will be allowed for time lost in late submittals or resubmittals.
- P. Processing time: Allow 10 full business days, not including weekends or holidays for engineer review of each submittal and resubmittal. Time for review shall commence on engineer's receipt of the electronic copy of the submittal, and ends once the submittal is returned electronically to the architect, contractor, construction manager, or any other party of record.

- Q. Contractor shall coordinate transmittal of different types of submittals for related parts of the work so processing will not be delayed because of the need to review submittals concurrently for coordination. Example: Boiler flue submittal when boiler has not been submitted (this may not apply to this project). A/E reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received. The engineer's processing time of the submittal does not begin until all required related submittals are received. Allow additional time if processing must be delayed to permit coordination with subsequent submittals.

1.12 ACCEPTABLE MANUFACTURERS AND SUBSTITUTIONS

- A. The products and equipment scheduled on the construction documents are basis of design. Where more than one manufacturer is listed, the contractor may use any of the acceptable manufacturers as the basis of their bids unless otherwise specified.
- B. Just because an acceptable manufacturer is listed, does not infer conformity of all construction document requirements, nor waive requirements thereof. The contractor and the manufacturer are responsible for verifying and complying with all construction document requirements.
- C. The construction documents showing the layout, arrangement, sizes, performance characteristics, weights, dimensions, electrical characteristics, and principal connections to the equipment are based on one particular piece of equipment which is the basis of design. If equipment other than the basis of design is used, it is the contractor's sole responsibility to coordinate and make all necessary modifications to the design and installation as a result of the change and ensure all modifications do not cause work delays. Example: Physical size, piping, ductwork, power characteristics, utility connections, structure and supports, architecture, etc. All necessary modifications include the modifications required not only for their work, but also the work of all other divisions/trades affected. The cost of making all the modifications shall be borne by this contractor without extra cost to any other party. The contractor shall also make arrangements with the other divisions/trades for such modifications and compensate them accordingly. In using such equipment, it is imperative that the equipment must fit the space and the access allotted, with the final layout to be approved by the A/E. Follow the construction documents as closely as actual building construction allows.
- D. Contractors and manufacturers may submit to the A/E additional proposed acceptable manufacturers not listed but meeting the construction documents for A/E approval and subsequent inclusion into the bidding documents. Submission must be received no later than 10 working days before bid date and before the final addendum. If approved, such manufacturers will be listed in an addendum. Submission must include performance data, electrical characteristics, dimensional data including required clearances, features, specified options, wiring diagrams, and any other information necessary to determine if the product or equipment will conform with the construction documents.
- E. Contractor shall submit product substitutions after bid date under provisions of Division 01 and as specified within this section. The most stringent requirements shall apply. Any request for substitution to a manufacturer other than the specified acceptable manufacturers must be submitted to the A/E in writing and shall include an adequate description of proposed change, reason(s) for requesting change, cost adjustment information, performance data, electrical characteristics, dimensional data including required clearances, features, specified options, wiring diagrams, and any other information necessary to determine if the product or equipment conforms with the construction documents. Substitutions not submitted in this manner will be rejected. Substitution requests will only be considered for the following reasons:
1. Alternate product is of equal quality, but better value with savings offered to the owner.
 2. Specified manufacturer(s) is no longer in business.
 3. Specified product(s) cannot be delivered within the required project schedule.

1.13 REQUESTS FOR INFORMATION/INTERPRETATION (RFIs)

- A. Contractor shall submit RFIs under provisions of Division 01 and as specified within this section. The most stringent requirements shall apply.

- B. Contractor shall carefully examine the entire set of construction documents (drawings and specifications) for all divisions/trades, review all applicable federal/state/local codes and standards, and perform field measurements on site. Immediately on discovery of the need for additional information, clarification, or interpretation of the construction documents due to any perceived ambiguity, conflict, error, omission, interference, discrepancy, or unforeseen condition, the contractor shall promptly prepare and submit an RFI and receive a response prior to proceeding with work.
- C. Contractor shall coordinate and submit RFIs in a prompt manner to avoid delays in their work or work of subcontractors and to not delay the construction schedule while allowing the full A/E response time. Contractor shall limit topics on each RFI to a single topic to expedite response. If more than a single topic is covered in an RFI the contractor accepts full responsibility for any and all cost or schedule delays if RFI is not answered in a timely manner. The contractor shall also be responsible for any and all cost or schedule delays from the necessity to resubmit an RFI due to insufficient or incorrect information presented in the original RFI.
- D. RFIs must be submitted by a contractor who is in contract directly with the owner. RFIs submitted directly by other entities controlled by the contractor, including but not limited, to equipment manufacturers, subcontractors, material suppliers, vendors, etc. will be returned with no response. The submitting contractor must perform a thorough review of the construction documents and all issues related prior to submitting an RFI.
- E. Contractor shall not submit RFIs related to means and methods, request for substitution, taking place of an action submittal, sequences of construction, lack of contractor coordination, or division of work among individual divisions/trades, subcontractors, equipment manufacturers, material suppliers, and vendors. Such issues are solely the contractor's responsibility and RFIs will be returned with no response.
- F. Any additional information, clarification, or interpretation of the construction documents made by anyone other than the A/E, or in any manner other than through the formal RFI submittal process, shall not be binding and the contractor shall not rely upon it.
- G. Content of the RFI: Include a detailed, legible description of item needing additional information, clarification, or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of contractor.
 - 5. Name of architect.
 - 6. RFI number, numbered sequentially.
 - 7. RFI subject.
 - 8. Specification section number, title, and related paragraphs, as appropriate.
 - 9. Drawing number and detail references, as appropriate.
 - 10. Field dimensions and conditions, as appropriate.
 - 11. Contractor suggested resolution(s). If contractor's suggested resolution impacts the contract time or the contract sum, the contractor shall state the impact in the RFI.
 - 12. Contractor's signature.
 - 13. Attachments: Include drawings/sketches, descriptions, measurements, photos, product data, shop drawings, coordination drawings, and other information necessary to fully describe items. Supplementary drawings prepared by the contractor shall include dimensions, floor level, rooms numbers, and structural grid references. Attachments shall be electronic files in PDF format.
- H. RFIs shall be submitted electronically using the project's web-based construction management software. If the project doesn't use a web-based construction management software, then RFIs can be emailed directly to the Advanced Engineering Consultant's (AEC's) project manager.
- I. Response time: A/E will review each RFI, determine action required, and respond. Allow seven working days for A/E response for each RFI. RFIs received by A/E after 1:00pm will be considered as received the following workday. A/E's action may include a request for additional information, in which case A/E's time for response will date from time of receipt of additional information.

- J. RFI log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly and when requested by owner or A/E. Include the following:
 - 1. Project name.
 - 2. Name of contractor.
 - 3. Name of architect.
 - 4. RFI number including RFIs that were dropped and not submitted.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date A/E's response was received.
 - 8. Identification of related minor change in the work, construction change directive, and proposal request, as appropriate.
 - 9. Identification of related field order, work change directive, and proposal request, as appropriate.
- K. On receipt of A/E's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify A/E within seven days if contractor disagrees with response.

1.14 COORDINATION AND FABRICATION DRAWINGS

- A. Construction documents for mechanical work are schematic in nature and are intended to convey scope and general arrangement only. Work shall be installed from the coordination and fabrication drawings which are fully coordinated, contractor generated, dimensioned drawings.
- B. Contractor shall prepare coordination and fabrication drawings. Prepare layout drawings of all systems of the construction documents including plumbing, industrial/medical gas, fire protection, HVAC, electrical, technology, fire alarm, controls, etc. All existing systems that are in the same area of new work must also be shown. Include completely dimensioned plans drawn to scale showing all equipment and distribution. Show above finished floor elevations for all items shown and where necessary provide sections. Provide reference dimensions to columns, walls, slabs, beams, and to components of other systems and work of other trades as necessary. Account for all insulation, jacketing, supports, hangers, bracing, inserts, sleeves, penetrations, etc for all systems. All items that require maintenance or adjustment must be installed in accessible locations and all required access/service clearances must be shown and must be clear of obstructions. Floor plans shall be drawn at not less than 1/4-inch scale. One set of coordination and fabrication drawings shall be provided showing all trades on a single plan for coordination verification with each division/trade shown as a different color and a second set of drawings shall be provided for each division/trade individually for layout verification and for help with clarity. The coordination and fabrication drawings when completed must contain dated sign off signatures for each discipline/trade contractor and then they are required to be submitted to A/E. Tracing or reproduction of the construction documents is not acceptable.
- C. Contactor cannot begin fabrication or install any work until the coordination and fabrication drawing submittal is processed as "reviewed for compliance" or "conforms as noted". Failure to follow this requirement may result in the fabricated or installed work to be revised or removed at the cost of the contractor. Contractors using the first to install method in lieu of coordination will not be tolerated.

1.15 OPERATION AND MAINTENANCE MANUALS

- A. Contractor shall submit operation and maintenance (O&M) manuals under provisions of Division 01 and as specified within this section. The most stringent requirements shall apply.
- B. Compile and assemble the operation and maintenance data for equipment listed in the equipment schedules or when specified in Part 1 of each specification section of the construction documents. Submit for Division 23 a separate set of new vinyl covered standard three ring binders along with an electronic (PDF) version. The manuals shall be tabulated and indexed (hard copy and electronic version) in accordance with the project specification numbering system and a table of contents shall be provided.
- C. The following items shall be included in the manuals:
 - 1. Each manual shall be labeled on the front cover with project name, contract, contractor's name, contractor's contact info, A/E, and date of substantial completion.

2. All final action, information, and closeout submittals.
3. Operating instructions, start-up, and shut down procedures.
4. Equipment error codes and troubleshooting instructions.
5. Manufacturer's equipment testing and adjusting instructions.
6. Maintenance instructions: Routine/preventative maintenance requirements and maintenance intervals.
7. Part list and reordering information.
8. List of recommended replacement parts (belts, filters, lubricants, etc.) for keeping in stock, including sources for purchase, and ordering information.
9. Warranty information: Contractor's warranty and manufacturer's warranty information. Warranty information shall include warranty start date, duration/end date, and contact information/procedures for filing a claim and obtaining warranty services.
10. Permit, inspection, and final inspection certificates.
11. Owner training videos

- D. Items that are larger than letter size paper shall be folded and punched for insertion in a manner that allows them to be unfolded without removing them from the manual with all information legible where possible.
- E. Manuals shall only include equipment that is provided for this project and all model numbers, options, and accessories shall be clearly indicated. Items that do not apply must be crossed out.

1.16 AS-BUILT AND RECORD DRAWINGS

- A. Contractor shall submit as-built drawings under provisions of Division 01 and as specified within this section. The most stringent requirements shall apply.
- B. Definitions:
1. As-built drawings: Drawings that are marked up in the field to reflect the actual installation conditions and all changes to the original construction documents. Typically, these mark ups are made using red ink directly on a hard copy set of the original construction documents. However, they can also be a set of the contractor's fabrication drawings as long as all field changes and install conditions are incorporated.
 2. Record drawings: The original construction documents that have been electronically revised to incorporate all addenda, post-bid bulletins, design revisions and as-built drawing differences.
- C. Contractor is to maintain as-built drawings for all existing services uncovered during construction (if applicable) and all new services being installed. As-built drawings shall be maintained in the field and shall capture the actual installation conditions and all changes to the original construction documents. These changes include but are not limited to plans, sections, elevations, details, routing, invert elevations, dimensions, quantities, sizing, controls, final location and arrangement of equipment, etc. At the completion of construction, the contractor shall submit the as-built drawings as an electronic (PDF) version to the A/E.
- D. The A/E will use the contractor's as-built drawings to create record drawings for the owner (unless specifically excluded from scope of work/contract). Record drawings are the record of the project as constructed based on information the contractor provides. It is important to note that the A/E does not confirm or verify the accuracy or completeness of the contractor's as-built drawings in the field. Since the record drawings are based on information by others, the A/E shall have no liability or responsibility for the accuracy of the information contained in such record drawings.

1.17 DELIVERY, STORAGE, HANDLING

- A. Equipment and material on the job site or in storage shall remain in the custody of the contractor until final owner acceptance, whether or not the owner has reimbursed the contractor for the equipment or material.
- B. Handle, store, and protect products carefully to prevent damage and theft before, during, and after installation. The contractor is solely responsible for the protection of their equipment and material against damage or theft. Do not install damaged items and if damaged, replace them with new items. If approved by the A/E and owner, items with minor damage may be repaired and installed.

- C. Where feasible, arrange for product delivery when construction has progressed enough to allow the products to be installed in their final location. When not feasible, minimize product storage on site as much as possible and store products protected from weather, physical damage, dust, debris, and moisture. Do not allow any materials or equipment to be stored in standing water or exposed to the elements. Store all plastics and electronics protected from direct sunlight.
- D. Deliver equipment, piping, and ductwork with factory applied end caps. Maintain end caps through shipping, storage, and handling to prevent end damage and entrance of dust, debris, and moisture.
- E. All electronic/powered equipment shall be covered in plastic until the environment/site is free of construction dust, debris, and moisture. Large equipment if shipped on open trailer trucks shall be covered with shrink on plastics or waterproof tarpaulins that provide protection from exposure to rain, road salts, and other transit hazards. Protection shall be kept in place until equipment is moved into the building and installed.
- F. Keep systems drained and free of standing water to prevent freezing and growth of bacteria, microorganisms, viruses, parasites, and fungi.
- G. All insulation, filters, and other items that can absorb water must be kept free from moisture at all times. If items absorb water, the items shall not be installed and if installed, they must be removed and replaced at the contractor's expense.
- H. At the time of rough installation, during storage, and until final startup of the HVAC systems, all equipment, duct, pipe, and other distribution component openings shall be covered with tape, plastic, sheet metal or other methods acceptable for protection to reduce the amount of dust, debris, and moisture which may collect in the system(s). Any item not protected shall be cleaned or replaced at the contractor's expense.

1.18 WARRANTY

- A. Contractor shall provide warranties under provisions of Division 01 and as specified within this section. The most stringent requirements shall apply.
- B. Contractor shall provide equipment and materials that have the required manufacturer's warranties that are listed in each individual specification section.
- C. In addition to the manufacturer's warranties, the contractor shall provide a warranty for all work they provide, they perform, and that is covered by the construction documents. The warranty shall cover work performed by the contractor and any subcontractor, supplier, vendor, etc at any tier. Contractor shall warrant all HVAC systems, equipment, materials, design furnished, and workmanship to conform to the construction documents and be free from any defect for a period of 1 year from the date of substantial completion of work.
- D. The contractor's warranty with respect to work repaired or replaced during the warranty period will run for an additional 1 year from the date of repair or replacement.
- E. During the warranty period, the contractor shall remedy without delay, at the contractor's expense, and without interference with the owner's operation (when possible), any failure to conform to the construction documents or any defect. In addition, the contractor shall remedy at the contractor's expense any damage to the owner owned or controlled real or personal property, when that damage is the result of the contractor's failure to conform to the construction documents or any defect.
- F. The contractor is also responsible during the warranty period for making adjustments to ensure operation of the various systems in accordance with the intent of the contract documents.
- G. If the contractor fails to adjust or remedy any failure, defect, or damage within a reasonable time after receipt of notice, the owner shall have the right to adjust, replace, repair, or otherwise remedy the failure, defect, or damage at the contractor's expense.

- H. Contractor shall obtain all warranties, require all warranties be executed in writing, and enforce all warranties for the benefit of the owner.
- I. Contractor is responsible to perform a mandatory walk through/final inspection with the owner at 10 months after the date of substantial completion of work to ensure all equipment and material are performing as required. Contractor's failure to perform the mandatory walk through at the 10 month time period from the date of substantial completion shall extend the contractor's warranty period to ensure the owner has a remaining two months of contractor warranty remaining after the mandatory walk through. If the owner chooses to decline the mandatory walk through, the warranty period extension shall not apply.

1.19 PROJECT CLOSEOUT & INSPECTIONS

- A. Contractor shall closeout project under provisions of Division 01 and as specified within this section. The most stringent requirements shall apply.
- B. Definitions:
 - 1. Substantial completion: The stage in progress of the work when the construction is sufficiently complete, in accordance with the construction documents, so that the owner has full and unrestricted use and benefit of the facility for the use for which it is intended. Incidental corrective or punch list work may still need to be completed. Seasonal functional performance testing/commissioning will still need to be completed (if applicable). This date is established with a certificate of substantial completion and it starts the warranty period.
 - 2. Final completion: The work is fully and finally complete in accordance with the construction documents. All incidental corrective and punch list work has been completed. As-builts and operation and maintenance manuals have been submitted by the contractor. Commissioning activities are complete and commissioning issues have been resolved. The owner, A/E, and contractor agree that all the requirements of the construction documents have been fully completed.
 - 3. Final inspection: A final walk through with the owner, contractor, construction manager, and A/E to verify final completion so that final owner acceptance can occur.
 - 4. Final owner acceptance: The written acceptance issued to the contractor by the owner after the contractor has completed the requirements of the construction documents. At this point the contractor is entitled to receive the remaining funds owned.
- C. The construction progress and the contractor's accuracy in following the construction documents will be periodically checked and inspected by the A/E (unless specifically excluded from scope of work/contract). The contractor shall be responsible for notifying the A/E at least two weeks in advance when any work to be covered up/concealed is ready for inspection. No work shall be covered up/concealed until approved by the A/E. If work is covered up/concealed without A/E approval, the contractor may be responsible for uncovering/unconcealing and recovering/reconcealing at no additional cost to the owner so that the work can be inspected.

PART 2 - PRODUCTS

2.1 EQUIPMENT SUPPLIED BY THIS CONTRACTOR

- A. Installation of HVAC, refrigeration, and fire suppression equipment shall not contain any CFCs, HCFCs, or halons. Use of asbestos products or equipment or materials containing asbestos is prohibited. Use of lead paint is prohibited. Use of mercury is prohibited.
- B. All materials, equipment, seals, bearings, packings, accessories, and piping specialties shall be suitable for the continuous operational temperatures, pressures, and characteristics of the system they serve.
- C. Install equipment, materials, etc. in strict accordance with the manufacturer's recommendations and direction. Provide straight inlet and outlet ducts/pipes based on equipment manufacturer's recommendations. Contractor shall also be responsible for start-up per manufacturer's recommendations

of all equipment and systems installed, modified, or revised. If in conflict with the construction documents, advise the A/E in writing prior to installation for clarification.

- D. Contractor furnishing an item of equipment is responsible for the proper handling, setting, installation, start-up, adjustment, and initial operation. If contractor is unfamiliar with the proper start-up and adjustment procedure of any equipment or system they furnish, they shall include the services of a qualified representative of the manufacturer or vendor to provide start-up assistance and for instruction of the owner's personnel.
- E. Equipment and components of equipment shall bear manufacturer's name, trademark, model number, serial number, and performance data on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

2.2 OWNER FURNISHED EQUIPMENT

- A. The owner will furnish the equipment and materials that are noted as such on the construction documents (if applicable). The contractor shall cooperate and coordinate with the owner in establishing the required delivery date(s) and these dates shall be designated in the contractor's construction schedule. The contractor shall review equipment shop drawings, product data, and manufacturer's installation instructions provided by the owner and manufacturer. If conflicts with the construction documents, discrepancies, or anticipated problems are found, notify the owner and A/E for direction. Owner furnished equipment may be contractor installed, contractor connected, or owner installed. Contractor shall assume all equipment noted as owner furnished is contractor installed unless noted otherwise in the construction documents.
- B. Owner furnished and contractor installed: The contractor is responsible for receiving, unloading, handling, setting/installing the equipment in place, making any required system/utility connections, and disposal of shipping/packing materials for owner furnished items. The owner and contractor shall jointly inspect items for damage upon delivery to the project site. If this inspection determines that owner furnished items are damaged, the owner will arrange for the necessary replacement or repairs. The contractor is responsible for protecting owner furnished items, upon receipt from owner and while in their possession, from damage during storage and handling and is responsible for damage caused to owner furnished items.
- C. Owner furnished and contractor connected: The contractor is responsible for making any required system/utility connections. The owner will arrange for delivery, unloading, handling setting/installing the equipment in place, and disposal of shipping/packing materials. The contractor is responsible for protecting owner furnished items from damage after the equipment is set/installed in place and is responsible for damage.
- D. Owner furnished and owner installed: The owner will arrange for delivery, unloading, handling, setting/installing the equipment in place, making any required system/utility connections, and disposal of shipping/packing materials for owner furnished items.

2.3 EQUIPMENT TURNED OVER TO OWNER

- A. The contractor shall remove, salvage, and turn over to the owner the equipment and materials that are noted as such on the construction documents (if applicable) as to not affect its reuse. The contractor shall disconnect, cap services/utility connections, remove equipment, clean equipment, pack/protect for delivery, and deliver to the owner. The owner and contractor shall jointly inspect items for damage prior to removal and shall document condition with photography. Once items are delivered to owner, the owner and contractor shall jointly inspect items for damage and shall document condition with photography. The contractor shall cooperate and coordinate with the owner in establishing the inspection and delivery dates. The contractor is responsible for protecting items turned over to the owner from damage during removal, handling, and delivery and is responsible for all damage.

2.4 EQUIPMENT TO BE REMOVED AND REINSTALLED

- A. The contractor shall remove and reinstall the equipment and materials that are noted as such on the construction documents (if applicable) as to not affect its reuse. The contractor shall disconnect, cap services/utility connections, remove equipment, clean equipment, pack/protect for storage, store, reinstall, reconnect, and make operational. The contractor is responsible for protecting removed and reinstalled items from damage during removal, handling, storage, and reinstall and is responsible for all damage.

2.5 PLENUMS

- A. Contractor is responsible for ensuring all materials installed within plenums are code compliant. When code requirements, the materials listed in other specification sections, or the materials specified within this section differ, the most stringent requirements shall apply.
- B. Definitions:
 - 1. Plenum: An enclosed portion of the building structure, other than an occupiable space being conditioned, that is designed to allow air movement, and thereby serve as part of an air distribution system.
 - 2. Occupiable space: An enclosed space intended for human activities, excluding those spaces intended primarily for other purposes, such as storage rooms and equipment rooms, that are only intended to be occupied occasionally and for short periods of time.
- C. Materials within plenums shall be noncombustible or shall be listed and labeled as having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E84 or UL 723.
- D. Combustible electrical wires and cables and optical fiber cables exposed within a plenum shall be listed and labeled as having a peak optical density not greater than 0.50, an average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet when tested in accordance with NFPA 262, or shall be installed in metal raceways or metal sheathed cable.
- E. Combustible optical fiber and communication raceways exposed within a plenum shall be listed and labeled as having a peak optical density not greater than 0.50, an average optical density not greater than 0.15, and a flame spread distance not greater than 5 feet when tested in accordance with UL 2024. Only plenum-rated wires and cables shall be installed in plenum-rated raceways.

2.6 GUARDS

- A. For machinery and equipment, provide guards (fan, pump, inlet/outlet, drive, shaft/coupling, etc) for belts, chains, couplings, pulleys, sheaves, shafts, gears, and other moving parts regardless of height above the floor to prevent damage to equipment and injury to personnel.
- B. Guards shall be sheet steel, expanded metal, or wire mesh rigidly secured to the machinery, equipment, or foundations using structural angle supports and anchor bolts.
- C. Guards shall be totally enclosed, removable, non-resonant, and shall be designed for easy access to items requiring replacement.
- D. Braces or supports for guards secured to motors will not be permitted and braces and/or supports must not bridge the sound and vibration isolators.
- E. Belt guards shall be designed with adequate provision for movement of motor required to adjust belt tension. Means shall also be provided to permit lubrication, speed measurement, and other maintenance and testing with guard in place.

2.7 MAINTENANCE MATERIALS, SPARE PARTS, AND FILTERS

- A. Contractor is responsible for the continued maintenance of all equipment furnished until the date of substantial completion of work. At that time, the contractor must submit to the A/E and owner the substantial completion maintenance requirements for all equipment which includes the following:
 - 1. The date the equipment arrived on site, installation date, start-up date, and all the dates maintenance (filters changes, lubrication, etc.) occurred with details of the specific maintenance task.
 - 2. A list including dates of all maintenance that the owner will need to complete during the warranty period.
 - 3. Manufacturer's equipment testing and adjusting instructions.
 - 4. Maintenance instructions: Routine/preventative maintenance requirements and maintenance intervals.
 - 5. Part list and reordering information.
 - 6. List of recommended replacement parts (belts, filters, lubricants, etc.) for keeping in stock, including sources for purchase, and ordering information.
- B. At substantial completion, the contractor shall furnish to the owner any special tools, keys, and instrumentation that may be required for the proper servicing, maintenance, disassembly, adjustment, or routine testing of all equipment provided. All tools and instrumentation shall be clearly labeled to indicate associated equipment and usage.
- C. Contractor shall provide one set of tools necessary for lubrication (grease gun with required attachments, etc.) for each motor or other equipment. Provide a minimum of 1 quart of each oil and 1 pound of each grease of the equipment manufacturer's recommended grade and type in unopened containers and properly identified as to the use for each different application.
- D. Contractor shall provide refrigerant system equipment, gauges, fittings, and tools required for system charging and evacuation for each type of refrigerant on the project.
- E. Contractor shall provide all spare and replacement parts that will be necessary for all equipment during the warranty period.
- F. Contractor shall provide two spare sets of each belt for all equipment at substantial completion.
- G. Contractor shall work and coordinate with all equipment manufacturers to attempt to standardize the filter types and sizes required across the entire project. The goal is to minimize as much as possible the types and number of sizes of filters required for the owner to simplify filter storage and replacement.
- H. Contractor shall replace all filters at substantial completion and then provide two complete spare sets of each filter for all equipment.

2.8 ACCESS DOORS AND PANELS

- A. Contractor is to provide all access doors and panels required for non-accessible surfaces (such as ceilings, walls, chases, ducts, etc.) so that all equipment, devices, and items that require maintenance, servicing, adjustment, or inspection are accessible whether shown or not on the plans. Access doors and panels for ceiling, walls, chases, and other architectural surfaces are to be installed by the general contractor (unless noted otherwise). Each contractor whose item or device requires the access door or panel shall bear the cost and shall be responsible for coordinating the location and size.
- B. Minimum access door and panel size shall be 12 inch by 12 inch for any item that requires only one hand to maintain, service, adjust, or inspect and 24 inch by 24 inch for any item that requires two hands to maintain, service, adjust, or inspect. Access door and panel size shall be increased as required to allow item to be easily maintained, serviced, adjusted, and inspected. Access door and panel finish shall match finish in which installed.
- C. Access for fire and smoke dampers shall be provided with an approved means of access, large enough to permit inspection and maintenance of the damper and its operating parts. Dampers equipped with fusible links, internal operators, or both shall be provided with an access door that is not less than 12 inch by 12

inch or provided with a removable duct section in accordance with NFPA 80. The access shall not affect the integrity of fire resistance rated assemblies. The access openings shall not reduce the fire resistance rating of the assembly. Access doors in ducts shall be tight fitting and suitable for required duct construction. Access points shall be permanently identified on the exterior by a label having letters not less than 0.5 inch in height reading: "FIRE/SMOKE DAMPER", "SMOKE DAMPER", or "FIRE DAMPER".

- D. Access door and panels installed in rated walls or assemblies shall be rated as required to maintain rating of assembly. Rated access doors shall bear UL label.

PART 3 - EXECUTION

3.1 SAFETY PRECAUTIONS DURING INSTALLATION

- A. Contractor shall take all measures to ensure safe installation of all work and to prevent injury to persons or damage to property in compliance with the Occupational Safety and Health Administration (OSHA) and all applicable regulations.
- B. Contractor shall erect scaffolds, platforms, supports, or other required construction to safely protect their own workers and other persons on site. Such items shall be designed and constructed by the contractor who shall be solely responsible for their adequacy and safety. A/E, owner, or user is not responsible for ascertaining the adequacy of any temporary structures used or erected by the contractor.
- C. For renovation and/or demolition work (if applicable), the contractor is hereby advised that it is possible that asbestos, lead based paints, mercury thermostats, and/or other hazardous materials are or were present in this building(s). Any worker, occupant, visitor, etc., who encounters any material of whose content they are not certain shall promptly report the existence and location of that material to the owner. Furthermore, the contractor shall ensure that no one comes near to or in contact with any such material, fumes, or dust until its content can be ascertained to be non-hazardous. The engineer has no expertise in the determination of the presence of any hazardous material. Therefore, no attempt has been made by the engineer to identify the existence or location of any such hazardous material. Furthermore, the engineer nor any affiliate hereof will not offer or make any recommendations relative to the removal, handling, or disposal of such material. If the work which is to be performed interfaces, connects, or relates in any physical way with or to existing components which contain or bear any hazardous material, then it shall be the contractor's sole responsibility to contact the owner and so advise the owner immediately. The contractor, by execution of the contract for any work and/or by the accomplishment of any work, thereby agree to bring no claim relative to other such item against the engineer, its principles, employees, agents, or consultants. Also, the contractor further agrees to defend, indemnify, and hold the engineer, its principals, employees, agents, and consultants harmless from any such related claims which may be brought by any subcontractors, suppliers, or any other third parties.

3.2 EXAMINATION OF SITE AND FIELD MEASUREMENTS

- A. Construction documents for mechanical work are schematic in nature and are intended to convey scope and general arrangement only. Exact locations and dimensions shall be determined by the contractor by examining the site, performing field measurements, and through the coordination and fabrication drawing process. Work shall be installed from the coordination and fabrication drawings which are fully coordinated, contractor generated, dimensioned drawings.
- B. Contractor shall base all measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Contractor must verify all measurements at the site prior, during, and after installation for accuracy. Should the contractor discover any discrepancy between actual measurements and those indicated which prevents following good practice and the intent of the construction documents, notify the A/E for direction and do not proceed with work until direction is provided.

- C. To aid in construction document clarity, all existing systems may not be shown. Field verify all sizes and locations of existing ductwork, piping, equipment, etc. Notify A/E of deviations which affect renovation work prior to proceeding with the work.

3.3 INTERRUPTIONS AND TIE-INS

- A. Review all construction documents to verify the extent and scheduling of all demolition/renovation (if applicable), and new work activities prior to commencing work.
- B. Ensure that the work will not interfere or interrupt services to areas outside of the designated contract areas. Schedule all work as to cause minimal service interruptions for the owner. Unavoidable interruptions are to be scheduled with the owner no less than two weeks prior to their expected commencement. Work shall be performed at such times as directed by the owner and, if possible, are to occur during off hours or off peak periods.
- C. The contractor is to verify the exact service of any existing piping or ductwork prior to installing any new connections. Any discrepancies between the construction documents or the design intent and actual conditions are to be brought to the attention of the engineer immediately, prior to fabrication or installation.
- D. Do not interrupt utilities or systems serving facilities occupied or partially occupied unless specifically allowed under the following conditions:
 - 1. Notify owner in advance of proposed utility or system interruptions. Identify extent and duration of utility or system interruptions and method of interruptions in detail.
 - 2. Do not proceed with proposed utility or system interruptions without owner's permission.
 - 3. Provide temporary utility or system services and connections as required.
 - 4. Once utility or system operation is restored, remove temporary utility or system services. Provide necessary blind flanges and caps to seal temporary connections.

3.4 PHASING

- A. All work is to be phased as indicated on the construction documents (if applicable). Contractor shall coordinate phasing of all demolition, renovation, and new work with other trades. It shall be the contractor's responsibility to coordinate and phase all tie-ins and interruptions of existing services to minimize or eliminate downtime. Closely coordinate phasing of work within corridors with the owner. Corridors may not be able to be completely closed off to pedestrian traffic. To accommodate phasing, corridor access work may need to be performed during off peak periods. Prior to moving on to the next phase, all work in previously phased areas must be complete and operational. The contractor shall install all new services and equipment and have them tested, fully functional, and reliably functional prior to interrupting, relocating, or removing any existing services. It shall be the contractor's responsibility to bare any and all costs associated with this phasing, including temporary services, temporary relocation, premium time work, etc.

3.5 SCHEDULING

- A. Contractor shall develop and maintain a construction schedule under provisions of Division 01 and as specified within this section. The most stringent requirements shall apply.
- B. Contractor shall coordinate and work with the construction manager, all contractors, manufacturers, vendors, commissioning agent, owner, A/E, and all other parties to develop a coordinated construction schedule. The construction schedule shall be a meticulously crafted timeline of activities, sequencing, milestones, and deliverables that make up the construction project. The construction schedule shall address durations, dependencies, lead times, the submittal process, the coordination process, start dates, completion dates, inspections, procurement, fabrication, delivery, and all work required as part of the construction process and it shall be broken down per task per contractor. Once construction begins, the schedule is a living document that continues to get updated and tracked.

- C. The coordinated construction schedule after being developed must contain dated sign off signatures for each discipline/trade contractor and then it is required to be submitted to A/E and owner.

3.6 COOPERATION AND COORDINATION BETWEEN DISCIPLINES/TRADES

- A. Contractor shall cooperate with all other disciplines/trades to provide the owner with a completed project on schedule.
- B. Coordinate the exact requirements, location, and clearances of work with the work of other trades prior to fabrication and installation. Provide additional offsets and sections in ductwork and/or piping required to meet the applicable job condition requirements. Verify job site elevations, dimensions, and conditions, prior to fabrication or installation of the work. Coordinate exact routing of ductwork and piping with other trades so that no conflicts occur with ductwork, piping, lights, structure, etc. Provide all pertinent data concerning the location, dimensions, etc., of the mechanical equipment that require bases, curbs, and supports to the appropriate trades. Work not appropriately coordinated shall be removed and properly installed at the expense of the responsible contractor(s).
- C. Coordinate the exact locations of air devices and all other ceiling mounted items with architectural reflected ceiling plans, area smoke detectors, sprinklers, lights, and electrical/technology devices. Air devices shall not be within 3 feet of an area smoke detector.
- D. Coordinate installation of supporting devices, sleeves, and openings in cast-in-place concrete and other structural components as they are constructed. Coordinate weights, forces, and anchors with structural contractor.
- E. Contractor to coordinate between the equipment suppliers, controls contractor, and electrical contractor as to which control and electrical (starters, disconnects, etc.) devices are supplied with equipment in lieu of being contractor provided.
- F. Contractor to coordinate between controls contractor and electrical contractor all control panel locations, control system power requirements, transformers, etc.
- G. Coordinate access door and panel sizes and locations required for non-accessible surfaces.
- H. Coordinate temporary construction and dust barriers with other divisions/trades.
- I. Prior to ordering any materials or rough-in of any kind, the mechanical contractor shall be responsible for final coordination of all electrical requirements (i.e. voltage, phase, circuit breaker, wire sizing, etc.) with the electrical contractor. There will be no change in the contract amount for any discrepancies.

3.7 ALIGNING EQUIPMENT TAGGING CONVENTION

- A. The contractor as part of the construction process, is responsible for working with the controls contractor, commissioning agent, testing/adjusting/balancing (TAB) contractor, and owner to develop and utilize an individual equipment naming, numbering, and tagging convention that could incorporate, but not be limited to the following items: building level, building area, room location, room served, and duct system. This convention must be approved by all parties prior to implementation. The tagging convention shall be consistent and reflected throughout all construction documents including but not limited to the submittal process, physical equipment nameplates, control graphics, TAB reports, O&M manuals, as-builts, and commissioning documentation.

3.8 RIGGING, SCAFFOLDING, AND HOISTING

- A. The design is based on making sure at least one method/scheme can be used by the contractor to deliver, move, locate, place, and set all equipment and materials. Alternative methods of equipment delivery may

be offered by the contractor and will be considered by the owner, A/E, structural engineer, and construction manager.

- B. Contractor shall be responsible for coordinating all required openings in the building structure/enclosure. All openings in the building structure/enclosure shall be performed and repaired by the general contractor. Contractor shall make sure all openings in the buildings are closed when not required to deliver equipment or materials.
- C. Contractor shall provide all necessary rigging, scaffolding, hoisting, lifts, cranes, tackle, tools, labor and other materials or equipment which may be necessary for the completion of work and such work shall be OSHA compliant. Contractor is also responsible for the removal of such rigging, scaffolding, and hoisting from premises when no longer required.
- D. Attachments to structures for rigging, hoisting, and supporting purposes shall be the contractor's full responsibility. Depending on the complexity of such rigging, hoisting, and supporting the contractor shall engage a qualified rigger and/or registered professional engineer as required. If the contractor is unclear about the structural adequacy of the building structure, the contractor must coordinate their rigging plan with the structural engineer of record.

3.9 GENERAL ROUTING OF WORK

- A. Construction documents for mechanical work are schematic in nature and are intended to convey scope and general arrangement only. The construction documents are also not intended to show every vertical and horizontal offset that may be necessary to complete the system or clear obstructions or the work of the other divisions/trades. All offsets, turns, fittings, trim, detail, etc., may not be indicated, but shall be provided as required. Install ductwork/piping neatly along walls and/or in horizontal groups and maintain required slopes. Work shall be installed from the coordination and fabrication drawings which are fully coordinated, contractor generated, dimensioned drawings.
- B. Coordinate new installations with existing installations (if applicable) which will remain in place and either be reutilized or be abandoned in place. Provide transitions and fittings in ductwork and piping as well as extra lengths of ductwork and piping as required to route around existing installations.
- C. All items that require maintenance, observation, inspection, cleaning, calibration, or adjustment must be installed in accessible locations with proper clearances maintained. Where possible install in locations that are accessible from floor level. Provide appropriately sized access doors as required at no additional cost to others whether shown or not on the plans, for access and maintenance. In general, contractor shall maximize clearance around all equipment as much as possible. The minimum clearance provided shall be the greater of the manufacturer's recommended clearance, the clearance shown on the construction documents, or the NFPA 70 / NEC (electrical components) required clearance. If clearances appear inadequate, notify the A/E for direction and do not proceed with work until direction is provided.
- D. Where ceilings are indicated, all ducts, pipes, and wiring shall be routed above ceiling, unless noted otherwise. In exposed conditions, install ductwork, piping, and wiring tight to the bottom of structure unless noted otherwise. In general, install all items to provide the maximum possible headroom, unless noted otherwise. All exposed wiring shall be run in conduit. Install items above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install all equipment, ductwork, piping, etc. straight and direct as possible, generally forming right angles with, or running parallel with, walls or adjacent ductwork, piping, etc. All ductwork, piping, etc. shall be neatly spaced with risers and drops running plumb and true. Where ducts, pipes, etc. are purposely pitched/slopped or required to be pitched/slopped for drainage or venting, an accurate grade shall be maintained. All items shall be supported in such a manner as to prevent sags, bends, and deflection sufficient to avoid pocketing.
- F. Run ductwork, piping, etc. in wall chases, shafts, hung ceilings, recesses, etc. where provided. Do not run in floor slab fill unless specifically noted on the construction documents. No work shall be covered up/concealed until inspected and approved by the A/E.

- G. Provide a minimum stand off distance of 1 inch between the outer surface of all items to avoid items from touching, vibrating, expanding, and rubbing against each other. The outer surface of an insulated item is the outer surface of the insulation jacketing. Install all items with enough stand off distance to allow application of insulation without compression.
- H. Connect all equipment for ease of disconnecting and removing with minimum interference to other installations.
- I. All supports for equipment, ductwork, and piping systems, and devices shall be from the building structure. Support from structural bridging is unacceptable. Supports shall be in accordance with latest ANSI and SMACNA standards.
- J. Unless noted otherwise, provide branch duct to diffusers same size as diffuser neck. Flexible duct connections to the diffuser shall be no more than 5 feet in length. In all duct systems, provide a manual balancing damper in each duct that requires an air balance. All branch duct takeoffs to air devices shall have a manual balance damper installed as close as possible to the branch duct takeoff to minimize noise at the air device. All manual balancing dampers shall be installed in an accessible location or controlled by a remote actuated damper.
- K. Provide shut-off valves within all supply piping branch takeoffs from mains. Provide a manual balance valve and a separate shut-off valve within all return piping branch take-offs from mains. Locate valves in accessible locations.
- L. Install all piping in locations and elevations such that coils, tubes, and filters can be removed and replaced without major piping removal. Locate valves in appropriate places to accommodate maintenance. For gravity flow piping, adequate slope shall be provided.
- M. Do not install piping, conduit, ductwork, etc., in a location or in a manner that will allow freezing and/or the collection of condensation.
- N. Contractor is responsible for draining, flushing, purging, and filling all piping systems as required and any additional isolation valves, drain valves, or air vents required to do so shall be provided. Provide drain valves at all hydronic piping low points and air vents at all hydronic piping high points.
- O. Firestop and seal watertight all floor penetrations and all rated wall penetrations. The annular space around the penetrating duct/pipe shall be protected with an approved noncombustible material that resists the free passage of flame and the products of combustion. Refer to architectural drawings for locations and type of fire and/or smoke rated building elements. All work shall be routed to minimize floor penetrations and rated wall penetrations.

3.10 ROUTING OF WORK IN ELECTRICAL ROOMS, TELECOM ROOMS, AND STAIRWELLS

- A. Electrical and telecom rooms: No HVAC work shall be routed in or through an electrical or telecom room unless the HVAC work serves the room. No hydronic systems or hydronic items, including condensate drain pans and associated condensate piping, shall be installed above any electrical panels, electrical equipment, or telecom racks/servers. In general, contractor shall maximize clearance around all equipment as much as possible. The minimum clearance provided shall be the greater of the manufacturer's recommended clearance, the clearance shown on the construction documents, or the NFPA 70 / NEC (electrical components) required clearance. If clearances appear inadequate, notify the A/E for direction and do not proceed with work until direction is provided.
- B. Stairwells: Per code, no HVAC work shall be routed in or through a stairwell unless the HVAC work serves the stairwell.

3.11 EQUIPMENT LOCATIONS

- A. All HVAC equipment that requires service shall be located within 25 feet of a 120 volt single phase, 15 or 20 Amp rated, GFCI protected receptacle outlet. The required receptacle outlet shall be located within the same room or area, and on the same level. Contractor is required to coordinate this requirement with the electrical contractor. If HVAC equipment cannot be located a minimum of 25 feet from a receptacle outlet, notify the A/E for direction and do not proceed with work until direction is provided.
- B. Provide room temperature thermostats with temperature indicator and setpoint adjustment, unless noted otherwise, for all equipment that maintains space temperature. Preferred locations are shown on the plans. Thermostats shall be mounted with centerline at 46 inches above finished floor, unless noted otherwise. Coordinate the exact locations of thermostats with furniture, framing, markerboards, switches, outlets, and any other wall mounted items prior to rough in. Coordinate to neatly align all thermostats in elevation with adjacent equipment from all divisions/trades.
- C. Contractor shall install all HVAC equipment on properly drained surfaces. Do not install HVAC equipment in pits or low areas that would appear to pool water.
- D. Contractor shall install all floor and outdoor grade mounted HVAC equipment on concrete housekeeping pads that comply with the equipment manufacturer's instructions and recommendations. Pads shall be 4 inches in height (or 3.5 inches using 2x4 lumber frame) and shall be not less than 6 inches larger in all directions than supported equipment, unless equipment manufacturer requires otherwise or noted otherwise in the construction documents. Contractor is responsible for coordinating the dimensions of all housekeeping pads using the actual purchased equipment dimensions.
- E. Roof mounted equipment:
 - 1. All roof mounted equipment that is powered is to be provided with an accessible weatherproof disconnect switch adjacent to the equipment.
 - 2. All roof mounted equipment that requires service shall be located a minimum of 10 feet from a roof edge unless the roof edge is provided with code compliant guards that are not less than 42 inches above the elevated surface adjacent to the guard. The guard shall be constructed so as to prevent the passage of a 21 inch diameter sphere and shall comply with the loading requirements for guards specified in code. If roof mounted equipment cannot be located a minimum of 10 feet from a roof edge and the roof edge doesn't have a code compliant guard, notify the A/E for direction and do not proceed with work until direction is provided.
 - 3. All roof mounted equipment shall be installed on 12 inch minimum height roof curbs or rails. All roof curbs and rails must have a minimum dimension of 8 inches from the top of the finished roof to the top of the curb/rail. Curbs and rails shall be unitized and fabricated of heavy gage sheet metal with full mitered corners and all seams welded, 1.5 inches thick rigid fiberglass insulation (curbs only), and pressure treated wood nailer strip. Rails shall have integral base plate. If taller height rails or curbs are called out elsewhere in the construction documents, meet the taller height requirement. When roofs are sloped/pitched, contractor shall provide sloped/pitched roof curbs or rails so the HVAC equipment is installed level.
 - 4. All duct and piping that connects to roof mounted HVAC equipment shall be properly installed and supported using duct and pipe supports, and roof penetration products. Products shall be similar to the types manufactured by the Pate Company or approved equal.
 - 5. Contractor is responsible for coordinating all roof mounted equipment locations with the electrical contractor so that proper lightning protection systems (if applicable) are installed. The contractor shall also coordinate their demolition scope with the electrical contractor prior to any demolition work so that existing lightning protection systems can be modified or relocated so that the building's lighting protection system stays active during construction.

3.12 NOISE, VIBRATION, AND EXPANSION CONTROL

- A. Contractor shall make provisions in their work so that noises and vibrations will not be transmitted through foundations, structure, floors, walls, columns, ducts, and piping, or other items and so that it will not be objectionable in any manner. All equipment and systems shall be selected and installed to minimize noise and vibration. If any equipment exceeds reasonable requirements as to quietness of operation and freedom from vibration when operating under continuous maximum demands, it shall be altered or replaced.

- B. Contractor shall provide vibration isolators for all HVAC equipment, fans, pumps, and piping systems as required by the construction documents. All reciprocating, or rotating equipment shall be isolated to reduce transmission of vibration into the structure even if not required elsewhere in the construction documents.
- C. Contractor shall work and coordinate with the noise and vibration control manufacturer and shall be responsible for the selection of the proper items for their loadings, quantities, floor span, and allowed isolator deflections.
- D. Special attention shall be given to the installation of ductwork and piping systems which have appreciable movement or expansion so that they will not hit other ducts, pipes, structural members, etc. under all conditions.
- E. Provide flexible connections or expansion compensators where ducts, pipes, etc. cross building expansion joints.
- F. All reciprocating or rotating equipment shall have associated systems connected to them using flexible duct/pipe connectors.

3.13 CUTTING, REPAIRING, PATCHING, AND REFINISHING

- A. All cutting, repairing, patching, and refinishing work in the mechanical work shall be included as part of the mechanical contractor's work, unless noted otherwise. All cutting, repairing, patching, and refinishing work in the work of other divisions/trades work shall be done by the associated other division/trade contractor at the mechanical contractor's expense. The mechanical contractor is responsible for coordinating, sizing, and locating this work with the other division/trade contractors. The mechanical contractor is responsible for maintaining the project schedule and any delay in mechanical work, lack of information, or lack of coordination with other divisions/trades shall be remedied at the mechanical contractor's expense without additional cost to others.
- B. Contractor shall be responsible for protection and shall repair adjacent surfaces, areas, equipment, systems, and property that may be damaged as a result of demolition and/or new work. Contractor shall remove and replace existing lay-in ceiling grid and tiles as necessary to complete above ceiling work. Return ceiling to original condition following completion of construction.
- C. Insulate ductwork and piping where existing insulation has been damaged and/or removed in the performance of work for this project. Insulation shall be compatible with existing materials. Notify the owner and A/E if other damaged and/or removed insulation is found that was not a result of the work for this project so that the owner can make the necessary repairs.
- D. All cutting, repairing, patching, and refinishing work in architectural type surfaces shall be performed by the general contractor. Patch and repair floor slab and wall penetrations to match existing color, materials, and texture where the piping, duct, or equipment is being removed or installed. Mechanical contractor to coordinate with general contractor.
- E. All roofing modifications shall be done by owner's roofing vendor to maintain any and all warranties. Cost to be included in this contract unless specifically included in general trades contractor's scope of work. Confirm owner's roofing vendor prior to bid.
- F. All cutting, burning, drilling, repairing, patching, and refinishing of structural items shall be prohibited without specific written consent of the structural engineer. The mechanical contractor is responsible for coordinating, requesting, and obtaining consent for such work.

3.14 CLEANING

- A. Contractor is responsible for providing continuous clean up during construction and shall assist in maintaining the premises in an orderly fashion at all times. Contractor shall remove all cartons, containers, and crates as soon as the contents have been removed and shall also remove all debris caused by work.

Deposit all discarded materials and debris in a suitable container and prevent these materials from being scattered by the elements. Remove debris arising from cutting, threading, welding, etc. immediately and flush, blowdown, pig, snake, etc. all systems as necessary. The contractor shall leave the work area in a broom clean condition or better at the end of each day. The contractor shall thoroughly clean their work, work area, and the equipment at the completion of construction and prior to substantial completion so that the work is spotless and free from dust, dirt, grease, rust, oil, and other foreign matter. Contractor shall leave the work in good housekeeping condition prior to occupancy, in a manner acceptable to the A/E.

- B. Contractor shall stack, organize, and store all construction materials associated with their work in areas so as to avoid congestion and interference.
- C. Contractor shall specifically keep the following items thoroughly cleaned and free from dust, dirt, and other foreign matter at all times throughout the construction process. Contractor shall again clean and verify all items are clean prior to balancing, commissioning, and substantial completion. Contractor shall use compressed air or other specialty cleaning tools as necessary to clean tight/ hard to reach areas. Solvents, cleaning materials, and methods recommended by the manufacturer shall be used for the specific tasks:
 - 1. Inside and outside surfaces of equipment.
 - 2. Electronic/powered items.
 - 3. Coil surfaces.
 - 4. Drain pans and drains.
 - 5. Cleanouts.
 - 6. Strainers.
 - 7. Air/dirt separators.
 - 8. Louvers and associated air plenums.
 - 9. Openings in ducts and pipes.
- D. If the HVAC systems are operated prior to air balance, provide temporary air filtration media that provides at least a MERV of 8 at all outdoor, exhaust, and return air intakes/grilles. These temporary air filters shall be removed prior to air balance. All HVAC filters shall be changed prior to air balance and commissioning, and again at substantial completion with filters per the construction documents.
- E. If the owner is occupying, operating, and/or using portions of the building during construction, the contractor shall provide all necessary items and work to contain all dust, dirt, debris, and other foreign matter in the work area and to not affect the other areas of the building. The contractor shall immediately clean as necessary to prevent all dust, dirt, debris, and other foreign matter from accumulating in the occupied, operated, and/or used portions of the building.
- F. Contractor shall be fully responsible for all costs, labor, damage, rework, delays, etc. arising from failure to clean and/or provide clean systems.

3.15 PAINTING

- A. Painting of all exposed-to-view pipes, ducts, hangers, supports, equipment, etc. shall be performed under another division/trade. This division/trade is responsible for making all HVAC exposed-to-view items paint ready. All rust shall be removed, and scratches, scuffs, and abrasions shall be repaired prior to painting. Areas shall be cleaned and dried prior to painting. Under this division/trade, all manufactured equipment shall be furnished with factory-finished baked enamel, unless otherwise specified.
- B. Do not paint or have someone else paint any item that should not be painted. Examples: moving parts, electronics, glass, screens, equipment nameplates, control items, items that are not recommended to be painted according to the manufacturer, etc. Do not paint closed air vents, hinges, panels, access doors, or other similar items that need openings or need to be opened.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish. Use manufacturer's paint (if applicable) and follow all manufacturer instructions.
- D. All painting shall be performed at the appropriate ambient temperatures and conditions per the paint manufacturer's instructions.

3.16 ALIGNMENT OF ROTATING EQUIPMENT

- A. All pumps, fans, etc. or similar equipment directly connected to motors by means of flexible couplings must have a precision alignment performed using a dial indicator or using laser shaft alignment equipment. The alignment work must be performed by a craftsman skilled in the work.
- B. Belted equipment shall be aligned so that the grooves of the driver pulley are truly aligned with those of the driven sheave, and the belts must be in the proper tension, free from flutter. All belt drives shall be set parallel and must be operated at the same plane.

3.17 LUBRICATION

- A. Before any rotating equipment is put into operation or for testing purposes, it shall be properly lubricated with lubricants recommended by the manufacturer, and they shall be further lubricated before the equipment is turned over to the owner during substantial completion.
- B. All lubrication points shall be accessible without disassembling equipment, except to remove access plates. Oil fill and drain line extensions shall be provided where necessary for convenient servicing of equipment.

3.18 SYSTEM START-UP

- A. All HVAC equipment start-up shall follow the manufacturer's start-up instructions and shall be performed by the personnel as described in the equipment specification. Depending on the complexity of the equipment, the equipment specification may allow or require the installation contractor, a manufacturer's representative, a manufacturer authorized service provider, or the manufacturer to start-up the equipment. The equipment start-up personnel are required to completely fill out the manufacturer's equipment start-up report paperwork/associated checklists and the start-up date shall be documented.
- B. The contractor is responsible for coordinating and having equipment start-up performed per the construction schedule. The installation contractor must notify the A/E, owner, construction manager, prime contractor, controls contractor, and commissioning agent (if applicable) two weeks prior to start-up of each item to coordinate, determine who needs to attend/observe, and to finalize the start-up date/timeframe.
- C. Equipment that is part of larger HVAC systems may need to be started-up sequentially or concurrently.
- D. The first step of equipment start-up is to perform the system verification/pre-start-up checklists. These checklists typically include items such as verifying all packing materials have been removed, inspecting equipment for damage, verifying proper equipment installation and clearances, checking refrigerant/gas/hydronic piping, checking electrical/control wiring, verifying proper lubrication/belt tension, checking fan/motor rotation, checking control dampers/valves, checking isolation damper/valve positions, etc.
- E. The second step of equipment start-up is for the controls contractor to perform the controls point-to-point checks and to document the results. These checks confirm that all control point wiring has been correctly installed and terminated, sensors have been calibrated, and field devices operate correctly. This involves physical observation of device responses to ensure they match control system displays.
- F. The third step of the equipment start-up is to start-up the equipment following the manufacturer's start-up instructions.
- G. Problems or incomplete work discovered in any of the system verification checks, controls point-to-point checks, or equipment start-ups must be corrected by the responsible contractor and re-tested to produce satisfactory results before proceeding to test/adjusting/balancing, and functional testing.
- H. Once system and equipment start-ups have been completed, the contractor shall submit to the A/E the associated start-up reports/checklists.

3.19 TESTING, ADJUSTING, AND BALANCING (TAB)

- A. An independent certified TAB contractor shall be used to test, adjust, and balance all air systems. Contractor shall follow the testing, adjusting, and balancing specification section (if applicable).
- B. The contractor shall inform the A/E as soon as the air systems are ready for balancing. A complete air system flow balance for all equipment that is shown, scheduled, or otherwise identified is required. Contractor shall include time in the construction schedule to fully test and balance systems prior to occupancy to assure adjustments can be made to mitigate comfort issues for occupants post construction.

3.20 PRE-FUNCTIONAL CHECKLISTS AND FUNCTIONAL PERFORMANCE TESTING

- A. Contractor shall utilize pre-functional checklists to ensure that the equipment and systems are hooked up and operational and that functional performance testing may proceed without unnecessary delays. Each piece of equipment shall receive full pre-functional checkout by the contractor. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation. However, some pre-functional checklist items entail simple testing of the function of a component. Pre-functional checklists augment and are combined with the manufacturer's system verification/pre-start-up checklists. The contractor is responsible for coordinating with the commissioning agent (if applicable) the pre-functional checklists, who needs to observe pre-functional testing, and the pre-functional testing date/timeframe.
- B. After TAB and the pre-functional checklists are complete, the contractor shall perform functional performance testing for all equipment and systems. The contractor is responsible for coordinating and having functional testing performed per the construction schedule. The installation contractor must notify the A/E, owner, construction manager, prime contractor, controls contractor, TAB contractor, and commissioning agent (if applicable) two weeks prior to functional performance testing of each item to coordinate, determine who needs to attend/observe, and to finalize the functional performance testing date/timeframe. The contractor is responsible for coordinating with the commissioning agent (if applicable) the functional performance testing procedure. The controls contractor may have to override normal control operation or parameters to simulate specific test conditions, and set up trend-logs to provide record of system responses to test actions.
- C. Contractor shall perform seasonal functional performance testing for all equipment and systems that could not be fully tested due to outside weather conditions during the functional performance testing timeframe. The seasonal functional performance testing might have to occur after substantial completion but must be prior to the mandatory walk through/final inspection with the owner that occurs 10 months after the date of substantial completion of work.
- D. If problems or incomplete work are discovered during functional performance tests, the contractor must correct or complete the work, and have it re-functional performance tested with satisfactory results.

3.21 OWNER TRAINING

- A. Contractor shall provide training to the owner's maintenance and/or engineering personnel to adjust, operate, and maintain all equipment and systems. The training shall be provided as described in the equipment specification. Depending on the complexity of the equipment, the equipment specification may allow or require the installation contractor, a manufacturer's representative, a manufacturer authorized service provider, or the manufacturer to provide the training. Training shall occur prior to substantial completion. Contractor shall also provide seasonal training for all equipment and systems that they could not fully train due to outside weather conditions during the original training timeframe. The seasonal training might have to occur after substantial completion but must be prior to the mandatory walk through/final inspection with the owner that occurs 10 months after the date of substantial completion of work.
- B. The operation and maintenance manuals shall be used as the basis for instruction. Review contents of manual in detail with the owner's personnel. Prepare and insert additional data in the operation and maintenance manuals when the need for additional data becomes apparent during instruction.

- C. Owner training shall include the following items:
 - 1. Start-up, operation, control, adjustment, and shutdown.
 - 2. Normal & unoccupied operations.
 - 3. System trouble shooting including the step by step procedure for determining the source of problems.
 - 4. Component trouble shooting including the diagnostic procedure for determining the source of the problems.
 - 5. Servicing & maintenance instructions.
 - 6. Required procedures for weekly, monthly, and annual preventative checks and timely repairs.
 - 7. Sources of spare parts and special tools.
 - 8. Special requirements of tenants/occupants for equipment and system function.
 - 9. Any special requirements or issues to maintain warranties.
 - 10. Relevant health and safety issues, concerns, and special safety features of each item.
- D. Training shall include the HVAC control system, associated sequence of operations, associated alarms, control programing, control trending, and operation during and after a power outage and fire.
- E. Training shall include classroom and hands-on time with the actual system and equipment.
- F. Training shall include a question and answer period.
- G. Contractor is responsible for coordinating and scheduling all training with the owner.
- H. Contractor shall record all owner training and provide two electronic copies on flash drives as part of the operation and maintenance manuals submittal. These videos are required to allow the owner to retrain existing personnel and to train new personnel hired.

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 alternating-current 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 NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

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. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Rotor: Random-wound, squirrel cage.

- E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating.
- G. Insulation: Class F.
- H. 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.
- I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- 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. 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. Grounding: Maintenance free, conductive micro-fiber shaft-grounding ring with a minimum of two rows of circumferential micro fibers to discharge shaft voltages away from the bearings to ground.
 - a. Motors 100 HP or Less: One shaft grounding ring installed either on the drive end or non-drive end.
 - b. Motors More Than 100 HP: Insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor.
 - c. All Motors: Bonded from motor foot to system ground with high-frequency ground strap of flat braided, tinned copper with terminations to accommodate motor foot and system ground connections.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

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.

2.6 ELECTRONICALLY COMMUTATED MOTORS (ECM)

- A. Motor: Brushless permanent magnet DC motor.
- B. Control: Integral control module to convert AC power to DC power and to generate three-phase signal to direct motor speed. Motor speed adjustment through 0-10 V DC input.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

SECTION 23 05 53

IDENTIFICATION FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Duct labels.
 - 4. Stencils.
 - 5. Warning tags.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product.
 - 2. Samples: For color, letter style, and graphic representation required for each identification material and device.
 - 3. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
 - 4. Valve numbering scheme.
- B. Closeout Submittals:
 - 1. Valve Schedules: For each piping system to include in operation and maintenance data.

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-quarters the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or 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-quarters the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or 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, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number 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) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

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-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or 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 DUCT LABELS

- A. General Requirements for Manufactured Duct Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Duct Labels: Printed plastic with contact-type, permanent-adhesive backing compatible with label and with substrate.
- C. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with system service lettering to accommodate both directions or as separate unit on each label to indicate flow direction.
2. Lettering Size: Character height at least 1 inch.

2.4 STENCILS

A. Stencils for Piping:

1. Lettering Size: Size letters according to ASME A13.1 for piping.
2. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

B. Stencils for Ducts:

1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
2. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
2. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

2.5 WARNING TAGS

A. Description: 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: Safety-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 GENERAL INSTALLATION REQUIREMENTS

- #### **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.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- B. 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 or 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 and on both sides of 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.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
 - 1. Chilled-Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 2. Condenser-Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 3. Heating Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 4. Refrigerant Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 5. Low-Pressure Steam Piping:

- a. Background Color: Yellow.
 - b. Letter Color: Black.
- 6. High-Pressure Steam Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
- 7. Steam Condensate Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.5 DUCT LABEL INSTALLATION

- A. Install duct labels on air ducts in the following color codes:
 - 1. Blue with White Lettering: For supply-air ducts in systems with mechanical cooling.
 - 2. Yellow with Black Lettering: For supply-air ducts in systems with heating and without mechanical cooling.
 - 3. Green with White Lettering: For exhaust-air, outside-air, relief-air, return-air, and mixed-air ducts.
 - 4. Yellow with Black Lettering: For combustion vents or flues and for class 3 or class 4 (as defined in ASHRAE 62.1) exhaust-air ducts.
- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic adhesive duct labels, at Installer's option.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 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.
- 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: 1-1/2 inches, round.
 - 2. Valve-Tag Colors: Natural.
 - 3. Letter Color: Black.

3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 05 53

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Balancing air systems.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Certified TAB reports.
- B. Informational Submittals:
 - 1. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
 - 2. Contract Documents Examination Report: Within 45 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
 - 3. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
 - 2. TAB Technician: Employee of the TAB contractor and certified by AABC or NEBB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard AABC or NEBB TAB forms.

- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.5 COORDINATION

- A. Notice: Provide at least seven days' notice before each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.6 HVAC CONTRACTOR RESPONSIBILITIES

- A. Provide TAB agency one complete set of contract documents, change orders, and approved submittals in digital pdf format.
- B. Control contractor shall provide required BAS hardware, software, personnel, and assistance to TAB agency as required for TAB agency to balance the systems. Control contractor shall also provide trending reports as needed to demonstrate that systems are complete.
- C. Coordinate meetings and assistance from suppliers and contractors as required by TAB agency.
- D. Provide additional valves, dampers, sheaves and belts as required by TAB agency.
- E. Provide access to all dampers, valves, test ports, nameplates, and other appurtenances as required by TAB agency.
- F. Remove and replace or repair insulation as needed to provide access for the TAB work.
- G. Have the HVAC systems at complete operational readiness before TAB begins.
- H. Promptly correct deficiencies identified during TAB.
- I. Maintain a construction schedule that allows the TAB agency to complete work prior to occupancy.

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.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- 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 systems and equipment controls.

- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenums are sealed (and fire-stopped if required).
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that might cause reduced capacities.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment under actual installed conditions. Use tables and charts in AMCA 201, "Fans and Systems" or in SMACNA "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, clean filters are installed, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, verifying that they are accessible and that their controls are connected, configured by the control contractor, and functioning.
- K. Examine two-way control valves for proper installation and function.
- L. Examine three-way valves for proper installation for their intended uses of diverting or mixing fluid flows and for proper function.
- M. Examine all equipment items to verify correct piping arrangements.
- N. Examine heat-transfer coils for correct piping connections and for clean and properly-spaced fins.
- O. 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:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for each equipment item.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. General:
 - a. Electrical power wiring is complete.
 - b. Control systems are operational.
 - c. Access is provided to balancing and control devices.
 - d. Variable frequency drive start-up procedures are complete.
 - e. Safety devices are operational and indicating normal status.
 - 2. Air Side:
 - a. Ductwork is complete with air terminals installed.
 - b. Balance, fire, and smoke dampers are open and operational.

- c. Control dampers are in their normal (fail) positions.
- d. Equipment and duct access doors are securely closed.
- e. Clean filters are installed.
- f. Fans are operating and rotating in correct directions.
- g. Fan vibration levels are within tolerance limits.
- h. Building envelope is complete, and exterior windows and doors are closed.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC "National Standards for Total System Balance" or NEBB "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
 - 2. Install new insulation where insulation is removed for TAB to match removed materials. Restore insulation, coverings, vapor barrier, and finish.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control devices, and similar controls and devices, with paint or other suitable, permanent identification material 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. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of system "as-built" duct layouts with all components identified.
- 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. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check condensate drains for proper connections and function.
- H. Check for proper sealing of air-handling-unit components.

3.5 PROCEDURES FOR CONSTANT-VOLUME AND VARIABLE-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow as follows:
 - a. Set outdoor air, return air, and relief air dampers for proper positions that simulate minimum outdoor air conditions.
 - b. Where conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

- c. Where conditions are not suitable for duct Pitot-tube traverse measurements, a coil traverse may be acceptable.
 2. Where sufficient space is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow. Measure fan static pressures as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the discharge flexible connection.
 - c. Measure inlet static pressure of single-inlet fan at the fan inlet or through the inlet flexible connection.
 - d. Measure inlet static pressure of double-inlet fan through the wall of the plenum that houses the fan or through the inlet flexible connections.
 3. Measure static pressure across each component that makes up the air-handling unit, rooftop unit, or other air-handling equipment. Report the cleanliness status of filters and the time static pressures are measured. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 4. Adjust fan speed higher or lower than indicated speed as needed to achieve indicated air-handling-unit performance.
 5. 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 mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for ducts to indicated airflows within specified tolerances.
 1. Measure airflows of branch ducts.
 2. Adjust branch duct balance dampers for specified airflows.
 3. Re-measure each branch duct after all have been adjusted.
- C. Adjust air outlets and inlets for each space to indicated airflows.
 1. Adjust each outlet in same room or space to 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. Measure airflows at all inlets and outlets.
 4. Adjust each inlet and outlet for specified airflow.
 5. Re-measure each inlet and outlet after all have been adjusted.
- D. Verify final system conditions.
 1. Re-measure and confirm minimum outdoor air, return air, and relief air flow rates are within design tolerances. Readjust as necessary.
 2. Re-measure and confirm total airflow is within design tolerance.
 3. Re-measure all final fan operating data. Include fan speeds, motor voltages, motor amperages, and static profiles.
 4. Mark all final settings.
 5. Test system in economizer mode. Verify proper operation; adjust if necessary. Measure and record all operating data.
 6. Record final performance data.

3.6 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Other Equipment with Fans: Plus or minus 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.

3. Hydronic Water Flow Rate: Plus or minus 10 percent.

3.7 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into a separate section for each tested and balanced system. Provide a final report that is a complete record of the HVAC system performance, including conditions of operation, any outstanding items, and any deviations found during the testing and balancing process. The final report is to provide a reference of actual operating conditions for the owner and operations personnel. All measurements and test results that appear in the report must be made on site and dated by the responsible technician or test and balance engineer.
- B. As a minimum the report shall include the following information:
 1. Title page, including:
 - a. TAB company name, address, and telephone number.
 - b. Project name, client, identification number, and location.
 - c. Project architectural firm, address, and telephone number.
 - d. Project HVAC engineering firm, address, and telephone number.
 - e. Project HVAC contracting firm, address, and telephone number.
 - f. TAB certification statement.
 - g. Test and balance engineer name, signature, and certification number.
 - h. Report date.
 2. Table of contents.
 3. TAB national performance guarantee.
 4. Report summary, including:
 - a. List of items that do not meet specified tolerances.
 - b. Information that may be considered in resolving deficiencies.
 5. Instrument list, including:
 - a. Type.
 - b. Manufacturer.
 - c. Model.
 - d. Serial number.
 - e. Calibration date.
- C. TAB test data for all systems included in the Work.

3.8 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. 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 or temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance positions.
 - e. Note deviations from the Contract Documents in the final report.
- B. Final Inspection:

1. After initial inspection is complete and documentation 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 Owner's Representative.
 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner's Representative.
 3. Owner's Representative shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to 10 percent of the total measurements recorded.
 4. If 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.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and adjust. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's payment.
- D. Prepare test and inspection reports.

3.9 SCHEDULE

- A. Provide hydronic and air balancing for each of the following equipment items as part of this work. Note that listing an item of equipment includes any motors, valves, dampers, and filters associated with that equipment:
1. Fans
 2. Control Dampers
 3. Air outlets and inlets
 4. Duct heaters
 5. Unit heaters
 6. Air-to-air energy recovery equipment
 7. Wall or ceiling heaters

END OF SECTION 23 05 93

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sheet metal ducts and fittings.
2. Sheet metal materials.
3. Duct liner.
4. Rectangular duct connection systems.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Requirements

1. ANSI/SMACNA 006-2006 (SMACNA 006) HVAC Duct Construction Standards – Metal and Flexible Third Edition. All ductwork shall be in conformance with this standard.
2. Structural Performance: Duct hangers, supports, and seismic restraints (where applicable) shall withstand the effects of gravity, wind, and seismic loads and stresses within limits and under conditions described in SMACNA 006, ASCE/SEI 7, and local requirements.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

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 the Architect/Engineer. Accompany requests for layout modifications with calculations showing the proposed layout will provide original design results without increasing system total pressure.

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of the following products:
 - a. Prefabricated ductwork and fittings.
 - b. Liners and adhesives.
 - c. Rectangular duct connection systems.
 - d. Sealants and gaskets.
 - e. Seismic-restraint devices.
2. Shop Drawings:
 - a. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

- b. Fittings, including details of construction.
 - c. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - d. Elevations of top and bottom of ducts along with applicable elevations of structural elements.
 - e. Dimensions of main duct runs from building grid lines.
 - f. Reinforcement and spacing.
 - g. Duct material and gauge thickness by pressure class.
 - h. Seam and joint construction.
 - i. Penetration details through fire-rated, smoke barriers and other rated partitions.
 - j. Equipment installation based on equipment being utilized on this project.
 - k. Duct accessories, including dampers, turning vanes, and duct access doors.
 - l. Area of application of acoustic duct liner where it will be applied.
 - m. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
 - n. Other systems installed in the same space as ducts where order of installation affects access.
 - o. Ceiling and wall mounted access doors and panels required to provide access to dampers, controls and other operating devices.
 - p. Ceiling mounted items, including light fixtures, diffusers, grilles, speakers, smoke detectors, sprinklers, other electrical devices, equipment and building structural members.
 - q. On each drawing, include a tabular list of each fan system's ductwork represented on that drawing and the total square foot surface area of each fan's duct system illustrated on the drawing.
 - r. Shop drawings shall be submitted prior to the fabrication or installation of the ductwork and serve as the foundation for coordination between various trades to maintain required ceiling heights.
- 3. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Failed test results and corrective action taken to achieve requirements.
- B. Leakage Testing Documentation: Contractor shall submit a written report to the authority having jurisdiction in which ducts designed at static pressures more than 3" wg pressure class have been leak tested and that the air leakage class is less than 6.0 per the Energy Code. Provide duplicate submittal to the Owner and the Engineer.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for steel hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum hangers and supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. NFPA Compliance: Applicable requirements in:
 - 1. NFPA 90A.
 - 2. NFPA 90B.
 - 3. NFPA 96.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1.
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Damage: Handle, transport, and store ducts to avoid damage. Damaged ductwork is not acceptable.
- B. Protection: Protect ducts from mechanical damage, weather, and exposure to chemicals (including road salt). Do not permit insulation materials to get wet under any circumstances. Remove insulation that is or has been wet from the project site, and replace the insulation with undamaged new materials.
- C. Ductwork and associated components shall be stored on blocking in a clean dry area to prevent damage and to prevent the entrance of dirt, debris, foreign matter and moisture.
- D. Ductwork shall be adequately supported during storage to prevent sagging or bending.
- E. Provide temporary storage, delivery and handling in accordance with SMACNA Duct Cleanliness for New Construction Guidelines, Intermediate Level.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA 006 based on indicated static-pressure class. The figure numbers below reference that standard.
 - 1. Transverse Joint: Figure 2-1.
 - 2. Longitudinal Seam: Figure 2-2.
 - 3. Pressure Class Gage and Reinforcement: Table 2-1 through Table 2-52 and Figure 2-3 through Figure 2-18.
 - 4. Elbow: Figure 4-2 (Use the following types only unless specifically approved by the Engineer.):
 - a. Type RE 1 (radius elbow).
 - b. Type RE 2 (square throat elbow with turning vanes).
 - c. Type RE 3 (radius elbow with vanes).
 - d. Type RE 5 (dual radius elbow).
 - e. Type RE 6 (mitered elbow without turning vanes) only for angles not greater than 45 degrees.
 - 5. Turning Vanes: Figures 4-3 and 4-4. Figure 4-9 short radius vanes in accordance with Chart 4-1 are acceptable.
 - 6. Branch Connection:
 - a. Diverging Flow: Figure 4-5 (all types). Figure 4-6 (following types only):
 - 1) 45-degree entry to rectangular branch.
 - 2) 45-degree lead-in to round branch.
 - 3) Conical connection.
 - 4) Bellmouth connection.
 - 5) Conical or bellmouth spin-in fitting only for pressure class 2" WG or less.
 - b. Converging Flow: Figure 4-5 (all types) and Figure 4-6 (all types). Conical or bellmouth spin-in fitting is acceptable only for pressure class 2" WG or less.
 - 7. Offset, Transition, or Obstruction: Figure 4-7 (all types) and Figure 4-8 (Figure B and C). Do not use Figure 4-8 Figure A (pipe through duct), Figure D (mitered offsets around obstruction, or Figure E (split duct around obstruction) unless specifically approved by the Engineer.
 - 8. Ductwork shall not be thinner than 26 gage.

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Duct Size: Fabricate ducts with indicated dimensions for the inner duct.
- B. Outer Duct: Comply with SMACNA 006 based on indicated static-pressure class.
- C. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A; and NAIMA AH124.
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
 - 3. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 4. Coat insulation with antimicrobial coating.
 - 5. Cover inner surfaces of insulation with polyester film complying with UL 181, Class 1.
- D. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A.
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
 - 3. Maximum Temperature: 180 deg F.
- E. Inner Duct: Minimum 24-gauge (0.028-inch) galvanized steel, stainless steel, or aluminum as indicated. Inner duct having 3/32-inch-diameter perforations, with overall open area of 23 percent. Solid, unperforated inner duct in fittings unless otherwise indicated. Solid, unperforated inner straight duct only if so indicated.
- F. General Fabrication Requirements: Conform to the equivalent single-wall duct requirements in the "Single-Wall Rectangular Ducts and Fittings" Article above based on the static pressure class and the size of the outer duct.
- G. Ductwork shall not be thinner than 26 gage.

2.3 SINGLE-WALL ROUND OR FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA 006 Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class.
 - 1. Transverse Joint: Figure 3-1 (all types).
 - 2. Longitudinal Seam: Figure 3-2 (all types). Do not use type RL-5 (grooved seam pipe lock or flat lock), RL-6 (snaplock), RL-7 (snaplock), or RL-8 (snaplock) seam for duct over 1" WG pressure class. Fabricate round duct larger than 90-inch diameter with butt-welded longitudinal seam.
 - 3. Pressure Class Gage and Reinforcement: Table 3-2 through Table 3-15 and Figure 3-3.
 - 4. Elbow: Figure 3-4. Use centerline radius of 1.5 diameters for each elbow unless space constraints prevent a radius that large; in that event, the radius may be reduced to that indicated in Table 3-1 with mitered segments. If space constraints prevent a radius as large as indicated in Table 3-1, a mitered elbow with turning vanes similar to Figure 4-3 and Figure 4-4 may be used. Do not use an adjustable elbow for duct over 1" WG pressure class.
 - 5. Branch Connection with Diverging or Converging Flow: Figure 3-5 and Figure 3-6. All types are acceptable for pressure class 2" WG or less duct. For pressure class 3" WG or more duct, use 90-degree tee fitting with oval-to-round tap, 45-degree lateral fitting, conical fitting, or wye fitting. Reducers may be incorporated into the fitting. Use only factory-fabricated fittings, not saddles or field-fabricated taps, for pressure class 3" WG or more duct.

6. Offset, Transition, or Obstruction: Figure 4-7 and Figure 4-8 modified for round or flat oval duct. Do not use Figure 4-8 Figure A (pipe through duct), Figure D (mitered offsets around obstruction), or Figure E (split duct around obstruction) unless specifically approved by the Engineer.
7. Flat Oval: Figure 3-7 and applicable figures for equivalent round duct.
8. Ductwork shall not be thinner than 26 gage.

2.4 DOUBLE-WALL ROUND OR FLAT-OVAL DUCTS AND FITTINGS

- A. Outer Duct: Comply with SMACNA 006 Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class.
- B. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A; and with NAIMA AH124.
 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 2. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
 3. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 4. Coat insulation with antimicrobial coating.
 5. Cover inner insulation surfaces with polyester film complying with UL 181, Class 1.
- C. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 2. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
 3. Maximum Temperature: 180 deg F.
- D. Inner Duct: Minimum 24-gauge (0.028-inch) galvanized steel, stainless steel, or aluminum as indicated. Inner duct having 3/32-inch-diameter perforations, with overall open area of 23 percent. Solid, unperforated inner duct in fittings unless otherwise indicated. Solid, unperforated inner straight duct only if so indicated.
- E. General Fabrication Requirements: Conform to the equivalent single-wall duct requirements in the "Single-Wall Round or Flat-Oval Ducts and Fittings" Article above based on the static pressure class and the size of the outer duct.
- F. Ductwork shall not be thinner than 26 gage.

2.5 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA 006 for 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: G90 unless otherwise indicated.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 or G90.
 2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils on sheet metal surface of ducts and fittings exposed to corrosive conditions and minimum 1 mil on opposite surface.
 3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts, listed and labeled for compliance with UL 181, Class 1.
- D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated.
- F. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- G. Factory- or Shop-Applied Antimicrobial Coating:
1. Apply to the surface of sheet metal that will form the interior surfaces of the duct. Apply an untreated clear coating to the exterior surfaces.
 2. Antimicrobial compound tested for efficacy by a nationally recognized testing laboratory and registered by the EPA for use in HVAC systems.
 3. Coating containing the antimicrobial compound with a minimum hardness of 2H when tested according to ASTM D 3363.
 4. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723.
 5. Shop-Applied Coating Color: Black or white, as indicated.
 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- H. Reinforcement Shapes and Plates:
1. Steel Duct: ASTM A 36/A 36M, steel plates, shapes, and bars; black or galvanized.
 2. Aluminum Duct: ASTM B209 alloy 6061-T6 members or steel members isolated from the aluminum with butyl rubber, neoprene, or EPDM gasket materials.
 3. Other Duct Materials: Reinforcement materials compatible with the duct materials at contact points.
- I. Tie Rods: Materials compatible with duct materials. Galvanized steel or stainless steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.
- J. Ductwork shall not be thinner than 26 gage.

2.6 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, and NAIMA AH124.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - a. Owens Corning.
 - b. CertainTeed Corporation: Insulation Group.
 - c. Johns Manville.
 - d. Knauf Insulation.
 2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy and registered by the EPA for use in HVAC systems.
 4. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
 5. Water-Based Liner Adhesive: Comply with NFPA 90A and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. 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."
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - a. Aeroflex USA Inc.
 - b. Armacell LLC.
 - c. Rubatex International, LLC.
 2. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 3. Surface-Burning Characteristics: Flame-spread index no greater than 25 and smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A. For indoor applications, adhesive with a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). 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. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- or 0.135-inch diameter shank, length to suit depth of insulation indicated with integral galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel, aluminum, or stainless steel (as appropriate); with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- D. Shop Application of Duct Liner: Comply with SMACNA 006 Figure 7-11, "Flexible Duct Liner Installation."
1. 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.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not install liner in rectangular ducts with longitudinal liner joints at locations other than corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams.
 7. 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.

8. 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:
 - a. Fan discharges.
 - b. Lined duct following unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are 2500 fpm or more.
 - d. Other locations as indicated.
9. Terminate liner with buildouts (metal hat sections) at dampers, turning vane assemblies, or other devices. Secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.7 RECTANGULAR DUCT CONNECTION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 1. Ductmate Industries, Inc.
 2. Hart & Cooley, Inc. Ward Industries.
 3. McGill Airflow LLC.
- B. Connection System: Rectangular duct transverse joint connection, reinforcement, and sealing system with roll-formed metal flanges, metal corner pieces, sealants, gaskets, and cleats.

2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a flame-spread index no greater than 25 and a smoke-developed index no greater than 50 when tested according to UL 723; certified by a nationally recognized testing laboratory.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Sealant: Modified styrene acrylic.
 3. Water resistant.
 4. Mold and mildew resistant.
 5. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 6. Service: Indoor and outdoor.
 7. Service Temperature: Minus 40 to plus 200 deg F.
 8. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 9. For indoor applications, sealant with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). For school projects, sealant 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. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).

7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, sealant with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). For school projects, sealant 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."
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts or other materials compatible with duct materials.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods; galvanized rods with threads painted with zinc-chromate primer after installation; or stainless steel all-thread rods and nuts.
- C. Strap and Rod Sizes: Comply with SMACNA 006 Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Cables:
1. Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
 2. Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
 3. End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports: Structural shapes and plates of materials compatible with duct materials and environmental conditions. Support material shall match duct construction material.

2.10 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Ductmate Industries, Inc.
 3. Hilti Corp.
 4. Kinetics Noise Control.
 5. Mason Industries.
 6. TOLCO; a brand of NIBCO INC.
 7. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized-steel or ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION GENERAL REQUIREMENTS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction losses for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings or Coordination Drawings.
- B. Install ducts according to SMACNA 006 unless otherwise indicated.
- C. Unless otherwise indicated, install ducts vertically plumb or horizontally level, and parallel and perpendicular to building lines. Avoid diagonal runs to maximum extent possible.
- D. Install ducts with a minimum clearance of 2 inch plus allowances for insulation thickness and access requirements.
- E. Cable hangers may only be used on low pressure (2" wg construction and lower) round spiral ductwork which is not insulated and has a diameter 10" or less. Utilize the double lock method such that the lower loop is clinched tight to the ductwork and the cable is vertical. Utilize manufacturer's top attachment device.
- F. Provide duct offsets needed to avoid interferences with structure, finishes, piping, other ducts, conduit, etc. Coordinate the work with all trades to minimize such offsets. Install ducts with fewest joints possible.
- G. Do not penetrate ducts with conduit or piping.

- H. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- I. Secure couplings with sheet metal screws. Install screws at maximum intervals of 12", with a minimum of 3 screws in each round metallic duct coupling.
- J. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections. Do not field-cut taps for branch connections in ducts with SMACNA pressure class magnitude more than 2 in wg.
- K. Install round or flat-oval ducts in maximum practical lengths to minimize joints.
- L. Do not install any duct in an electrical equipment room unless that duct serves that room.
- M. Do not install any duct in an elevator equipment room unless that duct serves that room.
- N. Do not install any duct over an electrical transformer, electrical switchgear, or an electrical panel unless approved in writing by the Engineer.
- O. Maintain clearances required in the National Electric Code for electrically-powered items.
- P. Where ducts pass through interior partitions or exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal type and thickness as the duct. Overlap openings on all sides by at least 1-1/2 inches.
- Q. Where ducts pass through fire-rated partitions, install fire dampers unless otherwise indicated. Comply with requirements in other Division 23 Sections for fire dampers.
- R. Where ducts pass through smoke partitions, install smoke dampers unless otherwise indicated. Comply with requirements in other Division 23 Sections for smoke dampers.
- S. Install ductwork takeoffs at smoke dampers such that there is a minimum of 24" between the damper and the start of the first takeoff.
- T. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts that are to be exposed in finished spaces from damage including dents, surface scratches, and markings. Exposed ducts must be undamaged and present a clean, neat appearance in materials and workmanship.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system in finished spaces.
- C. Grind welds to provide smooth surfaces free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets and inlets.
- E. Repair or replace ducts that do not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hoods.
- B. Install fire-rated access panel assemblies at each change in direction, at maximum intervals of 12 feet in horizontal ducts, at every floor penetration in vertical ducts, and elsewhere as indicated on Drawings. Locate access panel on top or side of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

- A. In accordance with ASHRAE 90.1, seal all ducts to SMACNA 006 seal class A with all transverse joints, longitudinal seams, and duct wall penetrations sealed. Seal openings for rotating shafts (including dampers) with bushings or other devices. However, do not seal an opening if sealing the opening would void a manufacturer's listing. Spiral lock seams in round or flat oval ducts do not require sealing unless leakage is detected.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA 006 Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA 006 Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports. Other types of hangers may be used if so indicated or if approved by Engineer.
- E. Vertical Ducts: Support vertical ducts with steel angles or channel secured to the sides of the ducts with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at maximum intervals of 16 feet.
- F. Upper Attachments: Install upper attachments secured to structural members. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials. Do not attach duct supports to roof decks.

3.6 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA "Seismic Restraint Manual: Guidelines for Mechanical Systems" or ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet on center and longitudinal supports a maximum of 80 feet on center.
 2. Brace changes of direction longer than 12 feet (or less if local requirements indicate a shorter length).
- B. Select seismic-restraint devices with capacities adequate to carry static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent items.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to building structural members such as flanges of beams, upper truss chords of bar joists, or concrete members.
- G. Drilling for and Setting Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, conduit, and piping.
 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. Install heavy-duty sleeve anchors with sleeves fully engaged in the structural elements to which anchors are to be fastened.
 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.7 CONNECTIONS

- A. Make connections to motorized equipment with flexible connectors complying with other Division 23 Sections. Comply with SMACNA 006 for branch, outlet, inlet, and terminal unit connections.

3.8 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a primer compatible with the duct material.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
1. Comply with SMACNA "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 2. Test ductwork sections that have a design static pressure class magnitude of 4-inch wg or more regardless of duct locations. Test representative duct sections totaling no less than **50** percent of total installed duct area. Obtain Engineer's approval of specific sections to be tested beforehand.
 3. Test all ductwork located outdoors.
 4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 5. Test for leaks before applying external insulation.

6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 7. Give at least seven days notice for testing.
 8. Tests must demonstrate that tested ducts meet SMACNA leakage class 4 or less. If any tested section of ductwork fails to meet this requirement, perform the following at no additional cost to the Owner:
 - a. Leak test 100 percent of the ductwork in every duct system with any failed section.
 - b. Provide additional sealing of ductwork to eliminate excessive leakage in failed sections. If necessary, replace duct sections.
 - c. Retest 100 percent of the ductwork in every duct system with any failed section.
 - d. Continue sealing and retesting until the entire system is proven to meet the leakage requirement. Note that once a section is proven to meet the leakage requirement that section does not need to be tested again unless it is damaged later.
- C. Duct System Cleanliness Tests:
1. Visually inspect duct system to ensure that no visible contaminants are present.
 2. Test sections of metal duct system, chosen randomly by Engineer, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems." The cleanliness level is acceptable if the net weight of debris collected on the filter media does not exceed 0.75 mg/100 sq. cm. Perform test in at least 10% of the ducts in a given system, but perform no less than one test per system.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.10 DUCT CLEANING

- A. Clean duct system(s) before testing, adjusting, and balancing in accordance with other Division 23 Sections.

3.11 DUCT CONSTRUCTION REQUIREMENTS

- A. Fabricate ducts with materials and pressure classes indicated on Drawings. Insulate ducts as indicated on Drawings or other Division 23 sections.

END OF SECTION 23 31 13

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Flange connectors.
 - 3. Turning vanes.
 - 4. Duct-mounted access doors.
 - 5. Duct access panel assemblies.
 - 6. Removable duct sections.
 - 7. Flexible connectors.
 - 8. Duct accessory hardware.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product.
 - a. For ceiling dampers include installation instructions.
- B. Closeout Submittals:
 - 1. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.
- C. Maintenance Material Submittals:
 - 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 2. Fusible Links: Furnish quantity equal to at least 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA 006 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.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or Type 316 as indicated. Unless indicated otherwise, No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- C. 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.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. 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 MANUAL VOLUME DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - 1. Ruskin Company.
 - 2. American Warming and Ventilating.
 - 3. McGill Airflow LLC.
 - 4. Nailor Industries Inc.
 - 5. Pottorff.
 - 6. Safe Air – Dowco Products.
 - 7. Vent Products Co., Inc.
- B. Round Manual Volume Damper: Diameter 20 inches or less, air velocity 1500 fpm or less, and duct static pressure class 2-inch or less. Galvanized steel sleeve with reinforcing beads. Single galvanized steel blade on axle with molded synthetic bearing at each end of axle and locking quadrant on standoff bracket. Basis of design Ruskin MDRS25.
- C. Round or Oval Manual Volume Damper: Diameter 48 inches or less, air velocity 4000 fpm or less, and duct static pressure class 10-inch or less. Galvanized steel construction for galvanized steel duct. Type 304 stainless steel construction for type 304 stainless steel or aluminum duct. Type 316 stainless steel construction for type 316 stainless steel duct. Rolled hat channel frame arranged for slip-in mounting. Single blade (or dual blades with center mullion for oval duct over 36 inches wide). Neoprene blade edge seals. Class II leakage rating. Blade mounted on axle with stainless steel sleeve bearing at each end of axle and locking quadrant on standoff bracket. Basis of design Ruskin CDR25 or CDO25.
- D. Rectangular Manual Volume Damper: Height 12 inches or less, air velocity 1500 fpm or less, and duct static pressure class 1-inch or less. Galvanized steel sleeve with blade stop. Single galvanized steel blade on axle with molded synthetic bearings and locking quadrant on standoff bracket. Basis of design Ruskin MD25.
- E. Rectangular Manual Volume Dampers: Height 5 inches or more, air velocity 1500 fpm or less., and duct static pressure class 3-inch or less. Galvanized steel hat channel frame with mitered and welded corners and blade stop. Flanged for attaching to wall and flangeless for installing in duct. Multiple single-thickness formed galvanized steel blades with opposed blade linkage enclosed in frame. Blades mounted on axles

with molded synthetic bearings. Control shaft extended beyond frame with locking quadrant on standoff bracket. Basis of design Ruskin MD35.

2.4 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - 1. Ductmate Industries, Inc.
 - 2. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Description: Add-on, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.5 TURNING VANES

- A. Manufactured 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.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA 006.
- D. Vane Construction: Single wall for vanes up to 48 inches wide and double wall for larger dimensions.

2.6 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA 006. Double wall, rectangular door. Galvanized sheet steel with insulation fill and thickness as indicated for duct pressure class. Butt or piano hinges and cam locks, quantities as indicated in SMACNA 006. Doors airtight and suitable for duct pressure class. Galvanized sheet steel frame with bend-over tabs and foam gaskets. Vision panel where indicated.
- B. Pressure Relief Access Door: Door and frame of galvanized sheet steel. Double wall door with insulation fill and metal thickness applicable for duct pressure class. Open outward for positive-pressure duct and inward for negative-pressure duct. Factory set at 3.0-inch to 8.0-inch wg positive or negative. Door retaining device. Neoprene or foam rubber seal.

2.7 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - 1. Ductmate Industries, Inc.
 - 2. Approved equal.

- B. Labeled according to UL 1978. Double-wall panel with two layers of steel, minimum 11 gage (0.12-inch thick) carbon or 11 gage (0.13-inch) stainless, steel type to match duct material. Carbon or stainless steel panel fasteners welded to inner wall and attached by threaded fasteners to outer wall. Fasteners shall not penetrate duct wall. Gasket complying with NFPA 96; grease-tight and airtight, high-temperature ceramic fiber, rated for minimum 2000 deg F. Minimum pressure rating 10-inch wg, positive or negative.

2.8 REMOVABLE DUCT SECTIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - 1. Langdon Inc.; model Sure-Clamp Access.
 - 2. Approved equal.
- B. Removable duct access section reinforced for duct pressure class of connecting ducts. Flanged duct section secured by clamps with lever latching devices. Gaskets within clamps to seal edges of flanges. Section at least 12 inches long in direction of airflow.

2.9 FLEXIBLE CONNECTORS

- A. Materials: Flame-retardant or noncombustible fabrics.
- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Metal-Edged Connectors: Fabricated with a fabric strip 5-3/4 inches wide attached to two 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.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene. Minimum weight 26 oz./sq. yd. Minimum tensile strength 480 lbf/inch in the warp and 360 lbf/inch in the filling. Service temperature range minus 40 to plus 200 deg F.
- E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone. Minimum weight 24 oz./sq. yd. Tensile strength 530 lbf/inch in the warp and 440 lbf/inch in the filling. Service temperature range minus 50 to plus 250 deg F.
- F. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber. Minimum weight 16 oz./sq. yd. Tensile strength 285 lbf/inch in the warp and 185 lbf/inch in the filling. Service temperature range minus 67 to plus 500 deg F.
- G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating. Minimum weight 14 oz./sq. yd. Tensile strength 450 lbf/inch in the warp and 340 lbf/inch in the filling. 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 structural-angle brackets for attaching to fan discharge and duct. Frame of 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. Outdoor spring diameter not less than 80 percent of the compressed height of the spring at rated load. Minimum additional travel 50 percent of the required deflection at rated load. Lateral stiffness more than 80 percent of rated vertical stiffness. Overload capacity support 200 percent of rated load, fully compressed, without deformation or failure. Elastomeric element molded, oil-resistant rubber or neoprene. Coil spring factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.10 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories in accordance with manufacturers' instructions.
- B. Install duct accessories according to applicable details in SMACNA 006 for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- C. 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.
- D. Compliance with ASHRAE/IESNA 90.1 restricts the use of backdraft dampers, and requires control dampers for certain applications. Install backdraft or control damper (as indicated) at inlet of exhaust fan or in exhaust duct close to exhaust fan unless otherwise indicated.
- E. Install volume dampers only in ducts constructed to magnitude 2" pressure class or less. Provide 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.
- F. Where volume damper is installed above a ceiling, provide 18-inch long high-visibility-orange ribbon hanging from damper operator.
- G. Set each damper fully open position before testing, adjusting, and balancing.
- H. Install test holes at fan inlets and outlets and elsewhere as indicated.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coil.
 - 2. Upstream and downstream from duct filter.
 - 3. At outdoor-air intake and mixed-air plenum.
 - 4. At drain pan.
 - 5. Adjacent to and close enough to fire or smoke damper to reset or reinstall fusible link. Door for access to fire or smoke damper having fusible link shall be pressure relief access door and shall be outward operation for access door installed upstream from damper and inward operation for access door installed downstream from damper.
 - 6. Elsewhere as indicated.
- J. Install access door with swing against duct static pressure.
- K. Access Door Sizes:
 - 1. One-Hand or Two-Hand Access: 12 by 12 inches.

2. Head and Hand Access: 18 by 12 inches.
 3. Head and Shoulders Access: 24 by 18 inches.
 4. Body Access: 30 by 18 inches.
 5. Body plus Ladder Access: 30 by 30 inches.
 6. Where duct width does not permit door size specified above, one dimension of door size may be reduced to 2 inches less than duct width.
 7. Access doors for fire dampers, smoke dampers, or combination fire and smoke dampers shall not be less than 12 inches by 12 inches. Where the duct size does not allow a door that large, provide a removable duct section located to give access to the internal damper components. Where duct is insulated, provide removable insulation over removable duct section as well as over clamps.
- L. Label access door as specified in another Division 23 Section to indicate the purpose of the access door.
- M. Install flexible connectors to connect ducts to equipment. If vibrating equipment is internally isolated from casing, provide rigid duct connections.
- N. For fan developing static pressure of 5-inch wg or more, cover flexible connector with loaded vinyl sheet held in place with metal straps.
- O. Install duct test hole where required for testing and balancing purposes.
- P. 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 starting and stopping of fan.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate each damper to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed and that door can open fully.
 3. Operate fire, smoke, and combination fire and smoke damper to verify full range of movement and verify that proper heat-response or smoke-sensing device is installed.
 4. Inspect turning vanes for proper and secure installation.
 5. Operate remote damper operator to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

SECTION 23 33 46

FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-insulated flexible ducts.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product.
 - 2. Shop Drawings: For flexible ducts. Include plans showing locations and mounting and attachment details.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- 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 SMACNA 006 "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.
- C. Comply with Air Diffusion Council "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 NON-INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill Airflow LLC.
 - 3. Thermaflex; a Flex-Tek Group.
 - 4. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Non-Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.

2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
- C. Non-Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire.
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.

2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
- B. Non-Clamp Connectors: Liquid adhesive plus tape.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA006 for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Provide flexible duct connections for all vibrating equipment.
- C. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- D. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions or correct misalignments.
- E. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- F. Connect flexible ducts to metal ducts with liquid adhesive plus tape or draw bands.
- G. Installation:
1. Install ducts fully extended.
 2. Do not bend ducts across sharp corners.
 3. Centerline radius of bends of flexible ducting shall not be less than one duct diameter.
 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 5. Install flexible ducts in a direct line, without sags, twists, or turns except as noted elsewhere.
- H. Supporting Flexible Ducts:
1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
 2. Install extra supports at bends approximately one duct diameter from center line of the bend.
 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
 4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches on center.

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END OF SECTION 23 33 46

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. In-line centrifugal fans.
 - 2. Propeller fans.

1.2 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevation.
- B. Operating Limits: Classify according to AMCA 99.

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
 - a. Certified fan performance curves with system operating conditions indicated.
 - b. Certified fan sound-power ratings.
 - c. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - d. Material thickness and finishes, including color charts.
 - e. Dampers, including housings, linkages, and operators.
 - f. Roof curbs.
- B. Informational Submittals:
 - 1. Field quality-control reports.
- C. Closeout Submittals:
 - 1. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.
- D. Maintenance Material Submittals:
 - 1. Belts: One spare set for each belt-driven unit.

1.4 QUALITY ASSURANCE

- A. AMCA Compliance:
 - 1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.

2. Operating Limits: Classify according to AMCA 99.
- B. 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.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

PART 2 - PRODUCTS

2.1 SQUARE IN-LINE CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 1. Greenheck Fan Corporation.
 2. Loren Cook Company.
 3. PennBarry.
 4. Twin City Fan & Blower.
- B. Housing: Epoxy-coated or galvanized steel square housing with straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting. Housing with inline and side discharge ports arranged for field conversion.
- C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts and fan pulley within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- F. Accessories:
 1. Companion Flanges: For inlet and outlet duct connections.
 2. Fan Guards: 1/2- by 1-inch mesh of aluminum, galvanized steel, or stainless steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 3. Motor and Drive Cover (OSHA Belt Guard): Epoxy-coated steel.

2.2 PROPELLER FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 1. Greenheck Fan Corporation.
 2. Hartzell Fan Corporation.
 3. Loren Cook Company.
 4. PennBarry.
 5. Twin City Fan & Blower.
- B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.

- C. Steel Fan Wheel: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
- D. Aluminum Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
- E. Direct Drive (Where Applicable): Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- F. Accessories:
 - 1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings and blade seals.
 - 2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
 - 3. Wall Sleeve: Galvanized steel to match fan and accessory size.
 - 4. Weather Shield Hood: Galvanized steel to match fan and accessory size.
 - 5. Weather Shield Front Guard: Galvanized steel with expanded metal screen.
 - 6. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through metal conduit.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors as indicated on Drawings and specified in another Division 23 Section. Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301. Factory test fans according to AMCA 300. Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210. Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fans and accessories in accordance with manufacturer's instructions.
- B. Install power ventilators level and plumb.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. Coordinate roof curb installation with General Contractor.
- E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- F. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 2 inches specified in another Division 23 Section.

- G. Install units with clearances for service and maintenance.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.
- B. Install ducts adjacent to power ventilators to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 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 where applicable.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Provide and 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.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

END OF SECTION 23 34 23

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.

1.2 SUBMITTALS

- A. Action Submittal:
 - 1. Product Data: For each product indicated, include the following:
 - a. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - b. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.
 - 2. Color Samples for Initial Selection: For each product with factory-applied color finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - 1. Titus.
 - 2. Price.
 - 3. Krueger.
 - 4. Hart & Cooley.
 - 5. Metalaire.
 - 6. Nailor Industries Inc.
 - 7. Tuttle & Bailey.

2.2 DIFFUSERS, REGISTERS, AND GRILLES

- A. Architectural Ceiling Diffuser:
 - 1. Material: Steel.
 - 2. Finish: Baked enamel, white.
 - 3. Face Size: 24 by 24 inches.
 - 4. Face Style: Plaque.
 - 5. Mounting: Lay-in or surface mount, refer to schedule.
 - 6. Accessories: Factory-insulated R-6 foil-backed insulation.

B. Square Ceiling Diffuser:

1. Material: Steel.
2. Finish: Baked enamel, white.
3. Face Size: 24 by 24 inches.
4. Face Style: Cones (three).
5. Mounting: Lay-in or surface mount, refer to schedule.
6. Accessories: Factory-insulated R-6 foil-backed insulation.

C. Sidewall Supply Grille:

1. Material: Steel.
2. Finish: Baked enamel, white.
3. Mounting: Surface or duct mount.
4. Face Arrangement: Double deflection.
5. Blades: Adjustable, front blades parallel to long dimension.
6. Blade Spacing: 3/4-inch.
7. Accessories: Opposed blade damper.

D. Exposed Spiral Duct Supply Grille:

1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Mounting: Duct.
4. Face Size: Refer to schedule.
5. Face Arrangement: Double deflection.
6. Blades: Adjustable, parallel to long dimension.
7. Blade Spacing: 3/4-inch.
8. Accessories: Air scoop damper.

E. Round Ceiling Diffuser:

1. Material: Steel.
2. Finish: Baked enamel, white.
3. Face Size: Refer to schedule.
4. Face Style: Cones (three).
5. Mounting: Duct.

F. Maximum Security Air Device:

1. Function: Supply or return
2. Face Plate: 3/16-inch steel with 5/16-inch diameter holes on 7/16-inch staggered centers and 1-inch border. All welded construction.
3. Sleeve: 3/16-inch steel.
4. Finish: Baked enamel, white.
5. Face Size: Refer to schedule.
6. Mounting: Surface.

G. Eggcrate Grille and Register:

1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Face Arrangement: 1/2-by-1/2-by-1/2-inch.
4. Face Size: Refer to schedule.
5. Frame: 1-1/4 inches wide.
6. Mounting: Lay-in or surface mount, refer to schedule.
7. Damper (Register Only): Adjustable opposed-blade assembly.

H. Sidewall Return Grille:

1. Material: Steel
2. Finish: Baked enamel, white.
3. Mounting: Surface or duct mount.
4. Face Arrangement: 35° Fixed.
5. Blades: Fixed, blades parallel to long dimension.
6. Blade Spacing: 3/4-inch.

I. Exposed Spiral Duct Return Grille:

1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Mounting: Duct.
4. Face Size: Refer to schedule.
5. Face Arrangement: 3/16-inch perforated holes on 1/4-inch staggered centers.

2.3 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.
- D. Provide sponge rubber gasket, mounting frame, and concealed fastener mounting on all surface mounted grilles and registers.
- E. Paint inside portion on all ductwork and plenums visible behind air device non-specular flat black enamel.
- F. Provide additional support for grilles, registers, and diffusers mounted in lay-in ceiling.
- G. Provide non-specular flat black steel blank-offs behind all unused portions of linear air devices.

- H. Coordinate exact location of Diffusers, Grilles and Registers with area smoke detectors, lights, and electrical devices. Air devices shall not be closer than 3 feet from area smoke detector.
- I. Final location of diffusers, registers and grilles shall be from architectural reflected ceiling plans.

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 37 26

FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fixed-blade louvers.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product. For louvers specified to bear AMCA seal, include submittal showing specified models with appropriate AMCA Certified Ratings Seals.
 - 2. Samples: For each type of metal finish required.
- B. Informational Submittals:
 - 1. Windborne-debris-impact-resistance test reports (for louvers rated for impact resistance).
 - 2. Sample Warranties: For manufacturer's special warranties.

1.3 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, Structural Welding Code – Aluminum.
 - 2. AWS D1.3/D1.3M, Structural Welding Code – Sheet Steel.
 - 3. AWS D1.6/D1.6M, Structural Welding Code – Stainless Steel.

1.4 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.5 WARRANTY

- A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
 - 1. 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 more than 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. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - 1. Ruskin Company.
 - 2. Airolite Company, LLC, The.
 - 3. Greenheck Fan Corporation.
 - 4. Mestek, Inc.; Air Balance Inc., American Warming and Ventilating, Arrow United Industries, or Louvers & Dampers.
 - 5. Nailor Industries, Inc.
 - 6. Pottorff.
 - 7. Vent Products Co., Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq. ft., acting inward or outward.
- B. Windborne-Debris-Impact Resistance: Louvers located within 30 feet of grade shall pass basic protection, when tested according to AMCA 540.
- C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Design earthquake spectral response acceleration, short period (Sds) for Project is as shown on structural drawings.
 - 2. Component Importance Factor: 1.0.
- D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- F. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED-BLADE LOUVERS

- A. Horizontal Nondrainable-Blade Louver:
 - 1. Basis of Design: Ruskin Model ELF6375X.
 - 2. Louver Depth: 6 inches unless indicated otherwise.
 - 3. Blade Profile: Plain blade without center baffle.

4. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
5. Mullion Type: Exposed.
6. Louver Performance Ratings: As scheduled.
7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

B. Horizontal Drainable-Blade Louver:

1. Basis of Design: Ruskin Model ELF6375DX.
2. Louver Depth: 6 inches unless indicated otherwise.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Mullion Type: Exposed.
5. Louver Performance Ratings: As scheduled.
6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
1. Use Phillips flat-head tamper-resistant screws for exposed fasteners unless otherwise indicated.
 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Post-installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E 488/E 488M conducted by a qualified testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.5 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.
 2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.
- C. Maintain equal louver blade spacing, to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
1. Frame Type: Channel unless otherwise indicated.
- E. Include supports, anchorages, and accessories required for complete assembly.

- F. Provide mullions of type and at spacings indicated, but not more than is recommended by manufacturer. Provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
- G. Provide subsills made of same material as louvers or extended sills for recessed louvers.
- H. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
- C. Color: As selected by Architect from full range of manufacturer's colors and color densities.
- D. Conversion-Coated Finish: AA-C12C42, nonetched, cleaned with inhibited chemicals, and chemical conversion coated with acid chromate-fluoride-phosphate.
- E. Factory-Primed Finish: AA-C12C42R1x with air-dried primer of not less than 2-mil dry film thickness.
- F. Baked-Enamel or 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.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, 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. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units, and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 23 37 26

SECTION 23 72 23

AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Packaged energy recovery units.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
 - 2. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Delegated-Design Submittal: For air-to-air energy recovery equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Detail fabrication and assembly of air-to-air energy recovery equipment.
 - b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - c. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
- B. Informational Submittals:
 - 1. Field quality-control reports.
- C. Closeout Submittals:
 - 1. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.
- D. Maintenance Material Submittals:

1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Filters: One set of each type of filter specified.

1.4 PERFORMANCE REQUIREMENTS

- A. AHRI Compliance: Comply with applicable sections of the following:
 1. AHRI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."
 2. AHRI 410, "Forced-Circulation Air- Cooling and Air-Heating Coils."
- B. ASHRAE Compliance: Comply with applicable sections of the following:
 1. ASHRAE 52.1.
 2. ASHRAE 62.1.
 3. ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."
 4. ASHRAE 90.1.
- C. NFPA Compliance: Comply with applicable section of the following:
 1. NFPA 70, "National Electric Code."
 2. NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."
- D. UL Compliance: Comply with applicable sections of the following:
 1. UL 1812, "Ducted Heat Recovery Ventilators."
 2. UL 1815, "Nonducted Heat Recovery Ventilators."
 3. UL 1995, "Heating and Cooling Equipment."

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for Packaged Energy Recovery Units: Five years.

PART 2 - PRODUCTS

2.1 PACKAGED ENERGY RECOVERY UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Engineered Air.
 2. Greenheck Fan Corporation.
 3. Loren Cook Company.
 4. RenewAire LLC.
 5. Trane.
- B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

- C. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 2-inch thick thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.
 - 1. Inlet: Weatherproof hood, with damper for exhaust and supply.
 - a. Exhaust: Gravity backdraft damper.
 - b. Supply: Gravity backdraft damper.
 - 2. Roof Curb: Refer to Division 7 for roof curbs and equipment supports.
- D. Heat Recovery Device: Cross flow energy recovery core.
- E. Supply and Exhaust Fans: Forward-curved, centrifugal fan with spring isolators and flexible duct connections.
 - 1. Motor and Drive: Direct driven.
 - 2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in other Division 23 sections.
 - 3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 4. Spring isolators on each fan having minimum 1-inch static deflection.
- F. Extended-Surface, Disposable Panel Filters:
 - 1. Comply with NFPA 90A.
 - 2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
 - 3. Factory-fabricated, dry, extended-surface type.
 - 4. Thickness: 2 inches.
 - 5. MERV: 8, according to ASHRAE 52.2.
 - 6. Refer to other Division 23 sections for additional filter requirements.
- G. Piping and Wiring: Fabricate units with space within housing for piping and electrical conduits. Wire motors and controls so only external connections are required during installation.
 - 1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.
 - 2. Outdoor Enclosure: NEMA 250, Type 3R enclosure contains relays, starters, and terminal strip.
 - 3. Include nonfused disconnect switches.
 - 4. Variable-speed controller to vary fan capacity from 100 to approximately 50 percent.
- H. Accessories:
 - 1. Duct collars.
 - 2. Rubber-in-shear isolators for ceiling-mounted units.
 - 3. Hinged access doors with quarter-turn latches.
 - 4. Mounting Brackets

2.2 CONTROLS

- A. Motion (Occupancy) Sensor: Passive infrared sensor for wall mounting with adjustable time-off delay of up to 30 minutes to energize unit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in other Division 23 sections.
- B. Install units with clearances for service and maintenance.
- C. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 DUCTWORK CONNECTIONS

- A. Ductwork installation requirements are specified in other Sections. Drawings indicate general arrangement of duct, fittings, and specialties.
- B. Where installing ductwork adjacent to air-handling unit, allow for service and maintenance.
- C. Connect ductwork to air-handling units mounted on vibration isolators with flexible connectors.

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Division 26.
- B. Ground equipment according to Division 26.
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection. Nameplates shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Division 26.

3.6 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. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Adjust seals and purge.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 4. Set initial temperature and humidity set points.
 - 5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION 23 72 23

SECTION 23 82 16.14

ELECTRIC-RESISTANCE AIR COILS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes electric resistance air coils.

1.2 SUBMITTALS

- A. Action Submittals
 - 1. Product Data: For each type of product.
 - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil.
 - b. Include rated capacities, operating characteristics, and pressure drops for each air coil.
 - 2. Shop Drawings: Include diagrams for power, signal, and control wiring.
- B. Closeout Submittals
 - 1. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - 1. Brasch Manufacturing Co., Inc.
 - 2. Chromalox.
 - 3. INDEECO.
 - 4. Markel
 - 5. Trane.
- B. Testing Agency Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Coil Assembly: Comply with UL 1995.
- D. Fin Tube Heating Elements: Coiled resistance wire of 80 percent nickel and 20 percent chromium; surrounded by compacted magnesium-oxide powder in tubular-steel sheath; with steel fins continuously

brazed to copper-plated sheaths. Elements arranged to minimize stratification when operating at less than full capacity.

- E. Open Coil Heating Elements: Open-coil resistance wires of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, and fastened to supporting brackets. Elements arranged to minimize stratification when operating at less than full capacity.
- F. Primary High-Temperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from duct or casing.
- G. Secondary High Temperature Protection: Load-carrying, manually reset or manually replaceable, thermal cutouts; factory wired in series with each heater stage and accessible through terminal box.
- H. Frames: Galvanized-steel channel frame, minimum 16 gauge (0.064 inch thick) for flanged mounting. Frames constructed with brackets, ribs, and gussets for rigidity.
- I. Frames: ASTM A 666, Type 304 or Type 316 stainless steel, minimum 16 gauge (0.0625 inch thick) for slip-in or flanged mounting. Flanged frames provided with pre-drilled mounting holes. Frames constructed with brackets, ribs, and gussets for rigidity.
- J. Control Panel: Mounted on coil assembly with interlocking disconnect switch and overcurrent protection. Terminal box totally enclosed including hinged door. Box insulated. Include the following controls:
 - 1. Magnetic contactors.
 - 2. Transformer with primary fusing.
 - 3. Supplemental circuit fusing.
 - 4. Time-delay relay.
 - 5. Pilot lights to indicate heater operation.
 - 6. Airflow proving switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA 006. Seal duct penetrations.
- C. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 requirements.
- B. Connect wiring according to Division 26 requirements.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 23 82 16.14

SECTION 23 82 39.16

PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes propeller unit heaters with electric-resistance heating coils.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. PTFE: Polytetrafluoroethylene plastic.
- C. TFE: Tetrafluoroethylene plastic.

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product.
 - a. Include rated capacities, operating characteristics, furnished specialties, and accessories.
 - 2. Shop Drawings:
 - a. Include plans, elevations, sections, and details.
 - b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Include location and size of each field connection.
 - d. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - e. Indicate location and arrangement of piping valves and specialties.
 - f. Indicate location and arrangement of integral controls.
 - g. Wiring Diagrams: Power, signal, and control wiring.
- B. Informational Submittals:
 - 1. Seismic Qualification Data: Submit certification that propeller unit heaters, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Include detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 2. Field quality-control reports.
- C. Closeout Submittals:

1. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.

1. Electric Unit Heaters:
 - a. Berko; Marley Engineered Products.
 - b. Engineered Air.
 - c. INDEECO.
 - d. Marley Engineered Products.
 - e. QMark; Marley Engineered Products.
 - f. Modine.
 - g. Trane.

2.2 DESCRIPTION

- A. Assembly including casing, coil, fan, and motor in vertical or horizontal discharge configuration as indicated with adjustable discharge louvers.
- B. 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.
- C. Comply with UL 2021.
- D. Comply with UL 823.

2.3 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1.
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- C. Seismic Performance: Propeller unit heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.4 HOUSINGS

- A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.5 COILS

- A. General Coil Requirements: Test and rate propeller unit-heater coils according to ASHRAE 33.
- B. Electric-Resistance Heating Coil: 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.

2.6 FAN AND MOTOR

- A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi. Static and dynamic balance.
- B. Provide fan guard.
- C. Motor: Permanently lubricated, constant Speed. Comply with requirements in other Division 23 Sections.

2.7 CONTROLS

- A. Control Devices:
 - 1. Unit- or wall-mounted thermostat as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for 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 propeller 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 spring hangers. Hanger rods and attachments to structure are specified in other Division 23 Sections.
- D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties. Piping installation requirements are specified in Division 23.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Comply with safety requirements in UL 1995.
- D. Ground equipment according to Division 26.
- E. Connect wiring according to Division 26.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 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.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust initial temperature set points.

END OF SECTION 23 82 39.16

SECTION 23 82 39.19

WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For each type of product.
 - a. Include rated capacities, operating characteristics, furnished specialties, and accessories.
 - 2. Shop Drawings:
 - a. Include plans, elevations, sections, and details.
 - b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
 - d. Wiring Diagrams: Power, signal, and control wiring.
- B. Closeout Submittals:
 - 1. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design.
 - 1. Berko; Marley Engineered Products.
 - 2. INDEECO.
 - 3. Markel Products; TPI Corporation.
 - 4. QMark; Marley Engineered Products.
 - 5. Trane.

2.2 DESCRIPTION

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

- B. 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.

2.3 CABINET

- A. Front Panel: Steel bar grille, with removable panels fastened with tamperproof fasteners.
- B. Finish:
 - 1. Steel surfaces: Baked enamel over baked primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
 - 2. Aluminum surfaces: Mill finish.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

2.5 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated. Comply with requirements in other Division 23 Sections.

2.6 CONTROLS

- A. Controls: Built in tamper-resistant thermostat.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for 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 wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Ground equipment according to Division 26.
- D. Connect wiring according to Division 26.

END OF SECTION 23 82 39.19

SECTION 26 00 10

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Descriptions
 - 2. Quality Assurance
 - 3. Record and Information Manuals
 - 4. Examination of Site
 - 5. Warranty
 - 6. Definitions
 - 7. Load Balancing
 - 8. Scheduling
 - 9. Coordination Between Trades
 - 10. Coordination with Utility Companies
 - 11. Owner Furnished Equipment
 - 12. Materials and Equipment
 - 13. Approved Equals
 - 14. Manufacturer's Declaration
 - 15. Installation
 - 16. Painting and Related Work
 - 17. Cutting, Patching, and Openings
 - 18. Tests
 - 19. Temporary Power
 - 20. Cleaning
- B. This Section applies to all sections of Division 26, 27, and 28.
- C. All applicable requirements of other portions of the Contract Documents apply to the work of all sections of Division 26, 27, and 28, including, but not limited to, Division 01, General Requirements.

1.2 DESCRIPTIONS

- A. The Contractor shall provide the labor, tools, equipment, and materials necessary to complete and leave ready for operation all electrical systems as called for in these specifications or shown on the drawings and all details essential to complete the work. Items omitted from either the specifications or the drawings, but shown or described in the other trades, and all items necessary to make the electrical system complete and workable shall form a part of the work. No "extras" will be allowed.
- B. By submitting a bid, the Contractor certifies that:
 - 1. He is satisfied that he understands all site conditions that may have an effect on his bid price.
 - 2. He fully understands the make-up, construction, and operation of all systems and equipment he is bidding on, and he has included in his price all materials, supplies, accessories, and services necessary to make these systems complete and operational.
- C. Extent of Work: Work under this contract consists of furnishing, installing, testing, placing into operation, and guaranteeing complete electrical systems as shown on the drawings and as specified in Division 26, 27, & 28. The Contractor shall connect and place all wired equipment in proper working order. Refer to the plans and specifications for work included in this Contract. Some general guidelines to coordinating work between Division 26 and other Divisions are as follows:

1. Division 26 includes all power wiring and raceways for other Divisions' equipment. Division 26 is responsible to furnish and install motor starters and disconnect switches for Division 21, 22 and Division 23 equipment, unless otherwise noted. Remote two wire control logic will be extended to the motor starters as work of other Divisions. Where combined line voltage power/control is used for Division 21, 22 or Division 23 equipment, the wiring and raceways are treated as power wiring and are work of Division 26.
2. Division 26 is responsible for providing appropriate wire and conduit between all distribution equipment and all electrical devices and utilization equipment shown on plans. It is also the responsibility of Division 26 to provide all wire, conduit, and devices necessary to accomplish all control functions as indicated by the control diagrams which are not specifically shown as work of another division.

D. Abbreviations used in these specifications:

1. ADA - Americans with Disabilities Act
2. ANSI - American National Standards Institute
3. ASTM - ASTM International
4. CBM - Certified Ballast Manufacturers
5. EIA - Electronic Industries Association
6. ETL - Electrical Testing Laboratories
7. FCC - Federal Communications Commission
8. ICEA - Insulated Cable Engineers Association
9. IEC - International Electro Technical Commission
10. IES - Illuminating Engineering Society
11. IEEE - Institute of Electrical and Electronics Engineers
12. ITL - Independent Testing Laboratories
13. NEC - National Electrical Code
14. NECA - National Electrical Contractors Association
15. NEMA - National Electrical Manufacturer's Association
16. NESC - National Electrical Safety Code
17. UL - Underwriters Laboratories
18. A/E - Architect of Record or Engineer of Record

1.3 QUALITY ASSURANCE

- A. Codes and Standards:** Perform all work in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
1. All work shall be installed in full accordance with the latest edition of the National Electrical Code (NEC) as prepared and published by the National Fire Protection Association (NFPA) and any applicable local or state codes. All electrical equipment shall be listed and labeled by Underwriters' Laboratories, Inc. (UL) or any approved independent nationally recognized electrical testing laboratory where such standards exist. Optionally, in lieu of such listing and labeling, equipment preapproved by the Electrical Inspector may be supplied. Wherever UL compliance is mentioned in the specifications, the above alternatives shall be understood to apply to all listing and labeling requirements. This does not preempt or replace the specifications or replace the approval process. All service switches/circuit breakers shall be listed and labeled as outlined above for service entrance duty.
 2. Comply with the requirements of NFPA Code 241 "Building Construction and Demolition Operations," the American National Standards Institute (ANSI) A10 Series standards for "Safety Requirements for Construction and Demolition," and the National Electrical Contractors Association (NECA) National Joint Guideline NJG-6 "Temporary Job Utilities and Services."
 3. In addition to the requirements outlined under other sections of the Contract Documents, all Work, material, and equipment shall comply with all requirements of the latest editions and interim amendments of the National Electrical Safety Code, National Fire Protection Association, OSHA, the building Owner's insurance company, and all applicable federal, state, and local laws and ordinances. All materials shall be listed and labeled by UL and installed as required by the listing.
 4. Should any changes in the Drawings or the Project Manual be required to conform to the above regulations, the Contractor shall notify the A/E at the time of submitting his bid. After entering the Owner-Contractor Agreement, the Contractor shall be held to complete all Work necessary to meet these requirements without additional expense to the Owner.

B. Permits and Regulations

1. The Contractor shall obtain all permits and inspections required by laws, ordinances, rules, regulations, and public authority having jurisdiction. The Contractor shall obtain certificates of such inspections and shall submit same to the A/E. The Contractor shall pay all fees, charges, and expenses in connection therewith. The Contractor shall furnish to the Owner a certificate of final inspection from the proper authority prior to final payment. Obtain and pay for easements required to bring temporary utilities to the site, where the Owner's easement cannot be utilized for that purpose.
2. The Contractor shall not allow or cause any of the Work to be covered up or enclosed until the A/E or Owner has been notified and given reasonable opportunity (2 working days) to review the Work. When required by law or regulations, the governmental agency having jurisdiction for inspections shall be given reasonable notice and opportunity to inspect the Work. Any Work that is enclosed or covered up before such inspection and test shall be uncovered at the Contractor's expense; after it has been inspected, the Contractor shall restore the Work to its original condition at his own expense.

C. Interpretation of Drawings and Project Manual

1. Any discrepancies between Drawings, Project Manual, Drawings and Project Manual, or within Drawings and Project Manual shall be promptly brought to the attention of the A/E for clarification during the bidding period. No allowance shall subsequently be made to the Contractor by reason of his failure to have brought said discrepancies to the attention of the A/E during the bidding period or of any error on the Contractor's part.
2. The locations of switch, receptacle, light, motor, outlets, etc. shown on Drawings are approximate. The Contractor shall use good judgment in placing the preceding to eliminate all interference with ducts, piping, etc. Where any doubt exists, the exact location shall be determined by the A/E.
3. Check all door swings so that light switches are not located behind doors. Relocate switches as required, with A/E's review.
4. All general trades and mechanical Drawings shall be checked by the Contractor before installing any outlets, power wiring, etc.
5. Equipment sizes and locations shown on the Drawings are estimated. Before installing any wire or conduit, the Contractor shall obtain the exact equipment requirements, including wire and conduit entrance locations, and install wire, conduit, disconnect switches, motor starters, overload heaters, circuit breakers, or other items of the correct size and locations for the equipment actually installed. However, wire and conduit sizes shown on the Drawings shall be taken as a minimum and shall not be reduced without written approval from the A/E.
6. The Contractor shall provide all wiring, including disconnect switches and starters for all electrically operated equipment shown on Drawings, specified or required, except that starters and/or disconnect switches need not be furnished where it is specifically noted that they are furnished with the equipment.
7. The Drawings show the general arrangement required for installation of equipment and materials. The Contractor shall follow these Drawings as closely as possible. Should conditions necessitate other arrangements, the Contractor shall prepare and submit drawings showing the changes to the A/E for review before proceeding with the Work.
8. The A/E reserves the right to make minor changes in the location of the installation of equipment and materials up to the time of roughing in at no extra cost to the Owner.
9. The Drawings do not show all offsets and do not detail every point at which unusual conditions of construction may require special attention. All additional fittings, conduits or specialties and other appurtenances necessary due to field conditions shall be provided by the Contractor.
10. In all cases where a device or part of the equipment is herein referred to in the singular number, it is intended that such reference shall apply to as many such devices as are required to complete the installations.
11. Wherever in Division 26, 27, & 28 a Manufacturer is specified with the notation "or approved equal" or "A/E approved", the decision as to the material or equipment being "equal" shall be made by the A/E without exception and this decision shall be accepted by the Contractor as final. Where the Contractor proposes to furnish equipment or material in accordance with the "or approved equal" notation said equipment or materials shall be submitted to the A/E, for review.
12. Elevators: The location of switches, receptacles, lights, telephone outlets, etc., in elevator pits and shafts shall be located as required by the elevator Shop Drawings. Elevator controls shall be interlocked with fire alarm system for elevator recall function and fire fighter control.

1.4 RECORD AND INFORMATION MANUALS

- A. Record drawings
 - 1. Prepare record documents in accordance with the requirements in Division 1 Section "Project Closeout." In addition to the requirements specified in Division 1, indicate installed conditions for:
 - a. Raceway systems, size, contents, and location, for both exterior and interior; locations of all concealed utilities; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 - b. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - c. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 - d. Any deviations made necessary to incorporate equipment different from the Design Base equipment.
 - e. At completion of the project, contractor shall deliver record drawings to the A/E.
 - 2. The Record drawings must be kept current and accurate, and may be reviewed at any time by the A/E or Owner.
- B. Operations and Maintenance Manuals
 - 1. Prepare maintenance manuals in accordance with Division 1 Section "Project Closeout." Compile and assemble the operation and maintenance data of equipment specified in Division 26 into a separate set of vinyl covered three ring binders, tabulated and indexed for easy reference. Data shall clearly indicate all options and accessories.
 - 2. The following items, together with any other necessary pertinent data, shall be included in each Manual:
 - a. Each manual shall be labeled on front cover with project name, Contract, Contractor's name, A/E, and date of project completion.
 - b. Manufacturers' names, nearest Factory Representative, and model and serial numbers of components of systems
 - c. Operating instructions, start-up and shut-down procedures
 - d. Maintenance instructions.
 - e. Routine and 24-hour emergency service/repair information:
 - f. Name, address and telephone number of servicing agency
 - g. Names of personnel to be contacted for service arrangements
 - h. Parts list with numbers of replaceable items, including sources of supply
 - i. Manufacturers' literature describing each piece of equipment
 - j. One approved copy of each submittal
 - k. Written warranties
 - l. Certificate of Material Receipt and Certificate of System Completion
 - m. One typewritten directory for each panelboard as installed
 - n. Record (as-built) drawings
 - o. Certificate of Final Inspection signed by Building Authority having jurisdiction
 - p. Test Results
 - q. Coordination analysis (see "26 05 72 Short Circuit, Overcurrent Protective Device Coordination, and Arc Flash Study")
 - r. Video tapes of all equipment demonstrations and training sessions.
 - 3. In addition to the requirements listed above and specified in Division 1, include the following information for equipment items:
 - a. Manufacturers' Descriptive Literature
 - b. Final Signed Submittal Copy of Shop Drawings
 - c. Spare Parts and Replacement Parts Lists
 - d. Manufacturers' Maintenance and Service Manuals
 - e. Project-Specific Description of Operation
 - f. Wiring Diagrams
 - g. Motor list including motor description, motor horsepower, motor voltage, fuse size, fuse type, and overload size.
 - h. Fuse list including fuse location, fuse size, fuse type, and load description.
 - i. Fixture Ballast Schedule
 - j. Lamp Schedule
 - 4. Materials for more than one item shall clearly indicate which item or items are included on the Project.
 - 5. Shop Drawings which are folded and punched for insertion in the Manual shall be such that the Drawings can be unfolded without removing them from the Manual, and all information shall be legible.

1.5 EXAMINATION OF SITE

- A. Certain existing conditions may affect the manner or sequence of the performance of work. Review existing services and structures prior to bidding the work. Review operating schedules for existing systems and services. Coordinate the scheduling of the work with existing operations.
- B. The contractor is encouraged to visit the site of the proposed project. After the contract is signed, no allowance will be made for lack of knowledge of the project conditions.
- C. Verify and reconcile work required by the contract documents with conditions at the site prior to bid.

1.6 WARRANTY

- A. Compile and assemble the warranties specified in Division 26 into a separate set of vinyl covered three ring binders, tabulated and indexed for easy reference.
- B. Provide complete warranty information for each item. Information to include:
 - 1. Product or equipment list.
 - 2. Date of beginning of warranty or bond.
 - 3. Duration of warranty or bond.
 - 4. Names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.7 DEFINITIONS

- A. Finished Areas: In general, areas with carpet or tile floors, lay-in or fixed ceiling tile, special architectural ceiling treatment, or tiled, plastered, or paneled walls shall be considered finished areas.
- B. Interior: For the purposes of this specification, interior is any area within the boundaries of the foundation of any building within the superstructure or other structures not classified as a building.
- C. Concealed: Embedded in or installed behind walls, within partitions, above suspended ceilings, below grade, in trenches, in tunnels and in crawl spaces.
- D. Exposed: Not installed underground or "concealed" as defined above
- E. Provide: To furnish and install (complete, tested, and ready for operation).
- F. Furnish: To purchase and deliver products to the project site and make ready for installation.
- G. Install: To take furnished products, assemble, erect, secure, connect, and place into operation.
- H. Products: Includes materials, systems and equipment.
- I. Work: The providing of products for entire contract.

1.8 LOAD BALANCING

- A. It shall be the responsibility of the Contractor to balance the loads on the service system, all distribution systems, and all power equipment so that the variation in amperes per phase readings shall not exceed 5% under normal operating conditions.
- B. Special care shall be taken during load balancing to prevent reverse rotation of motors.

- C. If, during load balancing, a load is shifted from one phase to another in a color coded system, the Contractor shall paint or tape the ends of the wire at all outlet points with the proper color code for that phase. Failure to do so shall constitute justifiable grounds to require the Contractor to replace the entire circuit with the proper coded wire at no expense to the A/E or Owner.

1.9 SCHEDULING

- A. General: It is mandatory that the facility be maintained in operation during construction and that periods of shutdown due to line changeovers, etc. are held to a minimum. These outages must be scheduled with and have the concurrence of the A/E and Owner. Further, it is mandatory that the completion of various stages of the electrical work coincide with the other phases of construction to maintain and permit operation of new installations as construction progresses.

1.10 COORDINATION BETWEEN TRADES

- A. General
 1. Coordinate all requirements of the Work of this Division with other Trade Contractors. Such requirements include, but are not limited to, locations, sizes, anchors, and similar items.
 2. Provide all necessary information to other Trade Contractors for such coordination. Such information shall include conforming Shop Drawings, conforming Product Data, and all other required data.
 3. This Contractor shall bear all costs for providing affected Work of related Trade Contractor(s) with no change to the Contract Sum or Date of Substantial Completion.
 4. This Contractor shall coordinate all of his/her work with the General Trades Contractor for location of all devices, fixtures and equipment prior to rough-in.
- B. Mechanical/Electrical Coordination
 1. Plumbing, Fire Protection, HVAC, and Electrical Contractors shall coordinate their rough-in, service, and control requirements with each other. Electrical Contractor shall review all control drawings to coordinate exact number and locations of temperature control panels as well as to provide proper starters (including necessary time delays, auxiliary contacts, etc.).
 2. All wiring required to power Plumbing, Fire Protection, or HVAC equipment shall be installed by the Electrical Contractor, including 120 volt to temperature control panels. All control and interlock wiring, regardless of voltage, is by the Contractor furnishing the control panel. The Division 28 Contractor shall be responsible for the wiring from the fire alarm control panel to the control device.
 3. All electrical devices furnished as a part of Division 23 equipment, and installation requirements of all electrical work done by Division 23 Contractors shall conform to the applicable sections of Division 26.
 4. Electrical Contractor shall coordinate with other Contractors prior to installation of switchboards and panelboards to insure requirements of NEC Articles 110 and 408 are met. The Contractor violating this requirement shall be responsible for the cost of all modifications required to comply to the satisfaction of the inspection agency for failure to meet the above code requirements.
 5. If motors and/or equipment are furnished by other Divisions, which require larger starters, safety switches, circuit breakers, fuses, and/or branch circuit conductors than indicated, due to a larger size than specified, the Contractor furnishing the motors shall reimburse the Electrical Contractor for any cost differential.
 6. Final operation of equipment provided under other Divisions shall be the responsibility of the other Divisions Contractor.
 7. Motorized dampers on exhaust fans shall operate when exhaust fan is energized. Wire dampers to their respective motor leads to energize the damper motor and open the damper when the fan runs. Equipment, including dampers, operator, and transformer (if required) will be furnished by the fan supplier. Motors fed from a variable frequency drive (VFD) shall be served from a separate branch circuit. Provide circuit to serve the dampers from the nearest panelboard (normal or emergency, to match motor). Control circuit through VFD damper control relay.
- C. Foundations, Bases, Curbs, and Supports
 1. Provide and coordinate all requirements for foundations, bases, curbs, and supports with the related Trade Contractor(s).

2. Provide required dimensions, templates, and all required information on anchors, sleeves, and cast-in-place accessories, including dimensions, to the related Trade Contractor(s).
- D. Openings, Recesses, and Chases
 1. Coordinate all requirements and locations for openings, recesses, and chases with the related Trade Contractor(s).
- E. Final Connections
 1. Coordinate with the related Trade Contractor(s) all requirements for rough-in and final connections for equipment installed under this Division.

1.11 COORDINATION WITH UTILITY COMPANIES

- A. Description
 1. The Division 26 contractor shall:
 - a. Coordinate division of responsibility with the utility companies serving the building.
 - b. Provide, furnish or install materials and labor not provided, furnished or installed by the utility companies.
 - c. Provide an allowance in the bid for utility aid-to-construction cost as follows:
 - i. Electric: \$xxxxx.xx
 - ii. Telecom: \$xxxxx.xx
 - iii. Cable: \$xxxxx.xx
- B. Division of work-electric power utility
 1. In general, the power company will do the following:
 - a. Provide standard riser
 - b. Provide primary cable
 - c. Provide load break connectors
 - d. Provide Terminators
 - e. Provide grounding
 - f. Provide security padlock
 - g. Provide meter
 - h. Furnish meter trim
 - i. Furnish metering transformers
 - j. Provide meter wire from metering transformer to meter
 - k. Provide transformer primary
 - l. Provide terminal pole and framing
 2. The electrical contractor is responsible for all other work, including the following:
 - a. Provide sleeve for grounding rod
 - b. Install meter trim
 - c. Provide conduit for meter wiring from transformer to meter trim
 - d. Provide guard post
 - e. Furnish easement or right-of-way
 - f. Provide concrete pad
 - g. Provide trenching
 - h. Provide primary duct
 - i. Provide secondary duct
 - j. Provide secondary conductors and lugs
 - k. Provide pulling wire, string, or rope, in duct
- C. Division of work-Telephone utility
 1. In general, the telephone company is responsible for all service cable work, including furnishing and installing main service copper, fiber and coax cables to the building.
 2. The electrical contractor is responsible for all other work, including the following:
 - a. Providing trenching and backfill for telecommunications service conduits.
 - b. Furnishing and installing telecommunications service conduits.

- c. Provide a minimum of a #6 solid copper ground wire from main building ground to telecommunication plywood backboard location. Provide the service entrance plywood backboard and a 120volt GFCI with TVSS double duplex receptacle.
- D. Division of work- – CATV and High Speed Data utility
 - 1. In general, the Cable TV & High Speed Data internet utility company is responsible for all service cable work, including furnishing and installing main service, fiber and coax cables to the building.
 - 2. The electrical contractor is responsible for all other work, including the following:
 - a. Providing trenching and backfill for cable and internet communications service conduits.
 - b. Furnishing and installing cable and internet service conduits.
 - c. Provide a minimum of a #6 solid copper ground wire from main building ground to telecommunication plywood backboard location. Provide the service entrance plywood backboard and 120volt GFCI with TVSS double duplex receptacle.

1.12 OWNER FURNISHED EQUIPMENT

- A. The Contractor shall make all necessary provisions for the Owner furnished equipment.
- B. The Contractor shall remove, receive, store, uncrate, protect, and install the equipment in place, complete with field connections between shipping splits, feeder connections, and all appurtenances required to place the equipment in operation, ready for use. The Contractor shall be responsible for the equipment when received, as if he had purchased the equipment himself.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. New material and equipment; all bearing manufacturer's name, model number, or other identification marking.
- B. Provide standard product; latest design with published properties of manufacturer regularly engaged in production of specified material or equipment for minimum 5 years (unless exempted by A/E).
- C. Unless otherwise scheduled or indicated, equipment of same type in same room must match as to color, finish, and design.
- D. Unless otherwise submitted to and approved by A/E, equipment and its devices must be of same manufacturer; or devices must be approved and warranted by equipment manufacturer.
- E. Whenever the Contractor furnishes equipment or material other than the Design Base Manufacturer specified, the Contractor is responsible for the cost and coordination of all modifications required not only for his work, but also for the work of all other Trades affected. Where changes to other Trades' work are required, this Contractor must include the additional costs of all such work in his bid and ultimately make arrangements with these other Trades for such changes and compensate them accordingly. Where changes to design are required, the Contractor shall submit such changes to the A/E for approval. The Contractor shall investigate potential conflicts such as the following:
 - 1. Provide Physical dimensions and weights
 - 2. Code required working clearances
 - 3. Connecting pipe sizes
 - 4. Additional control and interlock wiring
 - 5. Lug size and quantity
 - 6. Increased wire size, fuse size, and motor control equipment size
 - 7. Increased ventilation requirements
 - 8. Battery capacity
 - 9. Sound levels of audible devices

10. Increased withstand and interrupting ratings of downstream equipment due to differences in over-current protective device characteristics

2.2 APPROVED EQUALS

- A. Equal (equivalent) components (articles, devices, materials, forms of construction, fixtures, etc.) by manufacturers not listed but meeting the specifications may be submitted to the A/E for approval and subsequent inclusion into the bidding documents. Submission must be received no later than 10 working days before bid date. If approved, such manufacturers will be listed in an addendum.
- B. Submittals must include all of the following:
 1. Cover Letter: Company letterhead; addressed to A/E. Indicate the following
 - a. Project name, project number, and phase or bid package if applicable
 - b. Specification Section by number and title
 - c. Specified Product
 - d. Proposed Product
 - e. Deviations, if any, from Specified Product
 - f. List of attachments
 2. Product Data: Manufacturer's literature, fully describing proposed product with exact item highlighted or clearly indicated.
 3. Specifications: Manufacturer's specifications with all modifications noted as required to show compliance with Bidding Documents.
 4. Test Data: Where performance requirements are specified, submit laboratory tests to indicate compliance.
 5. Samples: Submit appropriate samples of proposed product when required by A/E, showing color, texture, construction and other attributes necessary for evaluation.

2.3 MANUFACTURER'S DECLARATION

- A. Submit a list of the suppliers of Major Equipment to be used on this project. This shall be submitted with the bid. This list shall be typed on company letterhead and shall list the project title. The manufacturer and catalog number/type shall be listed adjacent to each specification section number and product description.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Rough-In
 1. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
 2. Refer to equipment specifications in other Divisions for rough-in requirements.
- B. Electrical Installations
 1. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 - a. Coordinate electrical systems, equipment, and materials installation with other building components.
 - b. Verify all dimensions by field measurements.
 - c. Coordinate and provide chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 - d. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete or supported from or on other structural components, as they are constructed.
 - e. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning

- prior to closing in the building and equipment which must be placed in service before further construction can take place.
- f. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - g. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service and place each in proper operating order.
 - h. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that the work is shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the A/E before final placement.
 - i. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 - j. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
 - k. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.2 PAINTING AND RELATED WORK

- A. Finish painting in areas of new construction is the responsibility of the General Trades Contractor and is specified in Division 9.
- B. Any other painting, required by Sections in Division 26, is the responsibility of the respective Division 26 Contractor. It shall meet the requirements of Division 9. Each Contractor is responsible for repainting of finished areas disturbed by his own cutting and patching.
- C. Factory-finished equipment which has rusted or has been damaged shall be cleaned, spot primed with zinc chromate, and finished to the original quality and color by the Contractor.
- D. Support steel shall be cleaned, rust removed, primed, and painted.

3.3 CUTTING, PATCHING AND OPENINGS

- A. Unless otherwise required in General or Special Conditions, Contractor shall perform all cutting and patching required for his own work. Work must be accomplished in a neat and workmanlike manner, acceptable to the A/E.
- B. If necessary to cut into work of other Trades, it shall be done by other Trades at this Contractor's expense. Patching shall be similarly executed.
- C. Cutting, burning or drilling of structural support beams, joists, plates, or other structural members is strictly prohibited without the specific written consent of the A/E. Use rotary drills where cutting holes through concrete, brick, plaster, or tile is necessary. Obtain approval of the A/E before proceeding with work.
- D. The General Trades Contractor shall locate and size openings for conduit, bus-way or other items prior to construction.
- E. All cutting and patching shall be done promptly and all repairs shall be made as necessary to leave the entire work in good condition, including all cutting, fitting, and drilling of masonry, concrete, metal, wood, plaster, and other materials as specified or required for proper assembly, fabrication, installation, and completion of all work of the Contract.

- F. Patching shall match adjacent materials and shall be accomplished only by trades men skilled in the respective craft required. Materials and equipment used in the patching work shall comply with requirements of those Sections of the Specification relating to material to be used in new construction.
- G. Electrical provides:
 - 1. All opening and hole information through floors, walls, and roofs for his work; Including all pipe and conduit, inserts, hangers, and plates.
 - 2. Exact information to other contractors as to size, depth, and location of such openings before construction is in place; and delivery and setting in place of all boxes, sleeves, inserts, and forms for his work in time for installation in all locations.
 - 3. All cutting, patching and restoration to accommodate Electrical contractor's failure to provide specified date in time for openings to be left or to accommodate boxes, sleeves, inserts, and forms after construction has been Completed by other contractors.
 - 4. Skilled craftsmen to cut, patch, rebuild, restore, replace, refinish and repaint new construction cut, disturbed, or marred by him to original or new condition; for installation of new, exposed, concealed, underground, or underfloor work of all kinds; for admission of new work and equipment; for installation of new equipment and new work in new construction; for complete restoration of pipe, duct, or equipment covering disturbed or marred by his personnel.

3.4 TESTS

- A. The Contract Documents, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction may require portions of the work to be inspected, tested, or approved. These services shall be performed by approved agencies.
- B. The A/E must be notified of all scheduled tests and adjustments at least 48 hours before they are scheduled so that he may witness same. If the Contractor performs any test or adjustment without the A/E present, or without proper notification, the Contractor may be required to perform the test or adjustment a second time. All schedules are to be coordinated with the A/E and Owner far enough in advance so-as to minimize inconvenience.
- C. Tests shall include:
 - 1. Proper operation of lights and equipment.
 - 2. Continuity of conduit system.
 - 3. Insulation leakage and impedances.
 - 4. Ground system resistance.
 - 5. Any sub-system tests described in other Sections of these Specifications.
 - 6. Record line voltage at service entrance equipment with all systems operating.
- D. Provide a signed statement that all tests have been performed and have met all requirements as described in other Sections. This signed statement shall be incorporated into the Record and Information Manual.
- E. The Contractor shall bear all costs of such inspections, tests, or approvals.

3.5 TEMPORARY POWER

- A. Provide temporary electrical power to be used for construction purposes by all contractors in accordance with Division 1. Provide all fixtures, wiring, and equipment, and make all connections required for temporary electrical service during the construction period; coordinate all power and lighting requirements with the various trades. Contractor to pay for energy consumption, and any utility company charges to establish service.
 - 1. Temporary Service Panels: Provide a minimum of one 100 ampere rated service panel in a location or locations within 200 feet of all building work areas; include as many such panels as required to meet 200 foot maximum distance. Provide all wiring and raceways required for service connection and branch circuit wiring connecting each panel to the serving utility and to the following electrical loads; obtain all permits required.

2. Lighting: Provide minimum of 5 foot-candles of illumination in all building work areas where construction work is being accomplished; increase illumination to 50 foot-candles for painting, plastering and other interior fine finish work.
 3. Outlets: Provide duplex receptacle outlets on 100 foot centers maximum; arrange and locate so that no work area of the building is more than 100 feet from a 120-volt outlet; allow no more than 5 outlets on any 20-ampere circuit.
 4. Power Circuit Breaker: Provide one 100-ampere, 208-volt, 3-phase or 240-volt, 1-phase circuit breaker in each panel for power equipment.
- B. Power shall be obtained from the local electrical utility.
- C. Temporary power shall not be obtained from the generator purchased as part of this project.

3.6 CLEANING

- A. Upon completion of work, all materials and equipment furnished in this contract shall be thoroughly cleaned of dirt, grease, rust, and oil. Prepare for finish painting, where painting is specified.

END OF SECTION 26 00 10

SECTION 26 00 15

SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes administrative and procedural requirements for submitting shop drawings, product data, color samples, and other miscellaneous submittals.
- B. This section applies to all sections of Division 26, 27 and 28.

1.2 DEFINITIONS

- A. Action Submittals: Written information that requires the Engineer's responsive action. Materials and equipment submitted shall meet all the requirements of the Contract Documents. No materials or equipment shall be ordered until the submittal has been reviewed and processed as "Reviewed for Compliance" or "Conform as Noted" by the Contractor, Architect, and Engineer.
- B. Informational Submittals: Written information that does not require the A/E's review. Information is submitted for record purposes only and will not be reviewed by the A/E. It is the Contractor's responsibility to make sure materials and equipment comply with the Contract Documents prior to ordering. If reviewed however, the submittals may be rejected for non-compliance with the requirements of the Contract Documents.
- C. Reviewed for Compliance: The submittal was reviewed for compliance by the Engineer and the submittal was found to generally conform with the design concept and Contract Documents.
- D. Conform as Noted: The submittal was reviewed for compliance by the Engineer and the submittal was found to generally conform with the design concept and Contract Documents with the exception of the items noted. The items noted by the Engineer must be changed and/or included, however, the submittal should not be resubmitted.
- E. Revise and Resubmit: The submittal was reviewed for compliance by the Engineer and the submittal did not conform with the design concept and Contract Documents. The items noted by the Engineer must be changed or included and the submittal must be resubmitted.
- F. Does Not Conform: The submittal was not reviewed because it is incomplete, inadequate for review, or does not meet the submittal requirements listed in the 'Quality Assurance' section below. The Contractor shall review the submittal requirements and resubmit.

1.3 QUALITY ASSURANCE

- A. The review of shop drawings by the A/E does not relieve the Contractor from his/her responsibility to comply with the project documents nor does it authorize any additional cost. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities, dimensions and weights, for selecting fabrication processes, for techniques of assembly, for performing his/her work in a safe manner and for all coordination of the work with all trades.
- B. Contractor assumes complete responsibility for changes required and contract delays, including that of other trades, as a result of his/her chosen materials and equipment.

- C. All submittals shall bear the Contractor's certification that he/she has reviewed, checked, and approved the submittal, that they have been coordinated with the requirements of the project and the provisions of the Contract Documents, and that he/she has verified all field measurements and construction criteria, materials, catalog numbers, and similar data. Submittals without a Contractor's approval will not be reviewed, will not be returned, and the Contractor will be notified.
- D. Submittals shall identify the manufacturer, specific model number, performance data, electrical characteristics, overall size, features, specified options, wiring diagrams, and any other information necessary to determine if the product or equipment conforms with the contract documents. Contractor shall submit only material applicable for the project, where catalog pages are submitted the contractor shall identify the specific items that apply. Additional equipment specific requirements may be listed in other spec sections.
- E. Submittals shall include the complete package of equipment materials, piping, and insulation pertaining to that piece of equipment. A package of equipment requiring long lead times should be submitted as early as possible.
- F. Where other specification sections require field quality control reports to be prepared by a Qualified Testing Agency, submit testing agency qualification as part of the Informational Submittals. Testing Agency shall be a member company of NETA or an NRTL.
- G. All submittals must be issued individually by specification section.
- H. Submittals which do not conform with the requirements above WILL NOT BE REVIEWED; they will be returned to the Contractor marked "Does Not Conform".

1.4 SHOP DRAWING SUBMITTAL PROCEDURES

- A. Electronic copies of the Contract Documents are available from the A/E for Contractor's use in preparing submittals.
- B. Contractor shall submit electronic copies of all shop drawings in PDF format. Electronic submittals shall be emailed to submittals@aecmep.com and the AEC Project Manager. Other means of file transmission such as FTP or other file format types shall be mutually agreed upon.
- C. Contractor shall prepare a title page for each submittal containing the following information:
 - 1. Indicate name of firm and individual with contact information for entity that prepared each submittal.
 - 2. Project name as listed on contract.
 - 3. Specification section number and title.
 - 4. Material or Equipment specified.
 - 5. Date.

PART 2 - PRODUCTS

2.1 SHOP DRAWING SUBMITTALS REQUIRED

- A. Submit information for all equipment described in the specifications and on the drawings.

2.2 INFORMATION SUBMITTALS

- A. Equipment specific information submittals are listed within equipment specification sections. General information submittal requirements are listed below. Information submittals shall be provided when indicated within equipment specifications sections.

1. Qualification Data: For qualified testing agency
2. Seismic Qualification Data: Certificates, for equipment, accessories, and components, from manufacturer.
3. Source quality-control reports.
4. Field quality-control reports.

2.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Provide all information in bound 3-ring binder as well as digital format. Include the following information:
1. All approved shop drawings.
 2. All information submittal information.
 3. Contractor's warranty and any specific equipment warranty provided by equipment manufacturers.
 4. Inspection certificates.
 5. Routine maintenance requirements and maintenance intervals for installed components as well as the name and address of qualified service agencies for all major equipment.
 6. Manufacturer's written instructions for testing and adjusting equipment.
 7. Spare parts list.
- B. Project close-out material: Provide as described in Division 01.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Notify the A/E in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents. The Contractor must boldly note all deviations on the submittal.
- B. Make submittals promptly in accordance with the approved schedule and in such sequence as to cause no delay in the work of the Contractor or any other Contractor.
- C. Correct or change and then resubmit rejected submittals as required until approved. The Contractor must clearly note all revisions on resubmitted submittals. Resubmittals without the revisions noted may be returned without review.
- D. Do not begin fabrication or work that requires an Action Submittal until submittal is processed as "Reviewed for Compliance" or "Conform as Noted" by the A/E.

END OF SECTION 26 00 15

SECTION 26 00 20

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Sleeves
 - 2. Seals
 - a. Watertight Seals
 - b. Fire Rated Seals
 - c. Oil Resistant Service Seals
 - d. Corrosive Service Seals
 - e. Explosion Proof Seals
 - 3. Firestops
 - 4. Concrete
 - 5. Access Panels
 - 6. Coordination Drawings
- B. This Section applies to all sections of Division 26, 27, and 28.

1.2 SUBMITTAL

- A. Action Submittals:
 - 1. Manufacturer's product data sheets indicating product characteristics, performance and limiting criteria
 - 2. Manufacturer's installation instruction for each type of seal or firestop required by the project
 - 3. Written certification that firestopping systems meet firestopping requirements specified herein
 - 4. Concrete compression testing reports

1.3 QUALITY ASSURANCE

- A. Codes and Standards: Perform all work associated with basic electrical materials in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein. Where provisions of the pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - 1. American Institute of Steel Construction (AISC) "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings."
 - 2. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel."
 - 3. National Electrical Code (NEC).

1.4 COORDINATION

- A. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
- B. Field verify and coordinate with the General Trades Contractor all locations and dimensions to ensure that the equipment will be properly located, readily accessible, grouped with other trades equipment as

needed, and installed in accordance with all pertinent codes and regulations, the contract documents, and the referenced standards.

- C. The work shall be carefully laid out in advance, and where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary for the proper installation, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.
- D. In the event any discrepancies are discovered, immediately notify the A/E in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Seals
 - a. Link-Seal by Thunderline Corporation
 - b. CSD Sealing Systems
 - c. O-Z/Gedney Inc.
 - d. Crouse Hinds
 - e. Appleton
 - 2. Firestopping Materials
 - a. Hilti
 - b. Tremco Sealants & Coatings
 - c. 3M Fire Protection Products
 - d. Dow Corning
 - e. CSD Sealing Systems
 - f. Insta-Foam Products, Inc.
 - g. The Carborundum Co.
 - 3. Access Panels
 - a. Milcor
 - b. Zurn
 - c. Larsen's
 - d. Acudor
 - e. JL
 - f. Nystrom
 - g. Karp

2.2 SLEEVES

- A. Sleeve material through floors and walls shall be machine cut rigid galvanized steel conduit.
- B. Sleeves installed in new construction shall have welded flange at mid-point of sleeve which functions as a water barrier and anchor collar.
- C. At the contractor's option, steel wall sleeves by Link-Seal may be provided.

2.3 SEALS

- A. Modular mechanical type
 - 1. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between conduit and sleeve.

2. Seal assembly shall have steel bolts and nuts and rubber sealing element for service and environment under which assembly will be used. Seal shall have a pressure resistance rating of 20 psig.

B. Sealing plug type

1. Seals shall consist of two identical piece plugs made of synthetic rubber with one edge flanged, serrated profile on the outside and a series of ridges on the inside which compress and assures a tight seal. Seal shall have a pressure resistance of 15 psig at the plug base and 30 psig at the flange. Rubber grade shall be suitable for the service and environment under which sealing plug will be used.

2.4 WATERTIGHT SEALS

- A. Modular mechanical type watertight seals shall have zinc galvanized bolts and nuts with EPDM rubber sealing element. Seals shall be Link-Seal, Type C.
- B. Sealing plug type watertight seals shall be made of EPDM rubber. Seals shall be by CSD Sealing Systems.

2.5 FIRE RATED SEALS

- A. Modular mechanical type fire seal shall have zinc galvanized bolts and nuts with silicone rubber sealing element which provides a three hour fire resistance rating. Seals shall be Link-Seal, Pyro-Pac, model FS.
- B. Sealing plug type fire rated seals shall be made of FRR rubber for three hour fire resistance rating, Seals shall be by CSD Sealing Systems.

2.6 OIL RESISTANT SERVICE SEALS

- A. Modular mechanical type oil resistant service seals have stainless steel bolts and nuts with Nitrile rubber sealing element. Seals shall be Link-Seal, Type O.
- B. Sealing plug type oil resistant seals shall be made of Nitrile rubber. Seals shall be by CSD Sealing Systems.

2.7 CORROSIVE SERVICE SEALS

- A. Modular mechanical type corrosive service seals have stainless steel bolts and nuts with rubber sealing element having high resistance to most organic compounds, acids, alkalis and related chemicals. Seals shall be Link-Seal, Type S.
- B. Sealing plug type corrosive service seals shall be made by Viton rubber. Seals shall be by CSD Sealing Systems.

2.8 EXPLOSION PROOF SEALS

- A. Seals shall resist the passage of gasses, vapors, or flames and be UL approved for the application. Materials shall include iron alloy and/or ductile iron. Fill material shall be applied in place, after installation. The following features shall be included:
 1. Stainless Steel drain fittings shall be installed in vertical conduit runs to prevent the accumulation of condensate above the seal.
 2. Taper tapped hubs to assure grounding continuity.

2.9 FIRESTOPS

A. General

1. Use only firestop products that have been UL 1479, ASTM E-814 tested for specific fire rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
2. Cast-in-place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic pipe (closed and open piping systems), or electrical cable bundles, penetrating concrete floors.
3. Sealants, foams or caulking materials for use with non-combustible items including rigid steel conduit and electrical metallic tubing (EMT).
4. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including PVC jacketed, flexible cable or cable bundles and plastic pipe.
5. Foams, intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles.
6. Non-curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles.
7. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes.
8. Materials used for complex penetrations shall be made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
9. Non-curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
10. Firestopping materials shall conform to both Flame (F) and Temperature (T) Ratings as tested by nationally accepted test agencies per ASTM E-814 or UL1479 Fire Tests of Through-Penetration Firestops.
 - a. The F rating shall be a minimum of one (1) hour, but not less than the fire resistance rating of the assembly being penetrated.
 - b. Conduct the fire test with a minimum positive pressure differential of 0.01 inches of water column.

2.10 CONCRETE

- ### **A.**
- All concrete work incidentals to the work of Divisions 26, 27, and 28 is the responsibility of the Division 26 contractor. Such concrete includes, but is not limited to:
1. Encasement of underground raceways where specified in the section "Underground Ducts and Raceways"
 2. Lighting fixture foundations
 3. Service transformer pad
 4. Primary switch concrete pads unless noted otherwise on the Drawings. Coordinate exact pad requirements and location with the Electric Utility Company if they provide the transformer.
 5. Concrete collars around conduit and busway
 6. Emergency generator concrete equipment base
 7. Housekeeping pads

2.11 ACCESS PANELS

- ### **A.**
- Furnish ceiling and wall access panels as necessary for access to pull boxes, junction boxes, remote ballasts, electrical equipment, etc., requiring service, adjustment or maintenance.
- ### **B.**
- Access panels are to be turned over to the General Trades Contractor for installation.
- ### **C. Ceiling Access Panels**
1. Drywall Ceilings: 24" x 24", Milcor Style DW, 16 gauge steel frame with 14 gauge door panel, double acting concealed spring hinges, cylinder lock, prime painted for finish painting with ceiling.

2. Fire-Rated Ceiling: 24" x 24", Milcor fire-rated access door, UL approved, 16 gauge steel frame with 18 gauge recessed door panel, 20 gauge panel sides and 26 gauge panel hat channel, continuous hinge, self-latching cylinder lock, prime painted for finish painting.
 3. Plaster Ceilings: 24" x 24", Milcor Style AP with finish material same as ceiling material or Style K, 16 gauge galvanized steel frame with 18 gauge galvanized steel door panel. 24" x 24" and larger panels shall be reinforced, continuous hinge, cylinder lock, prime painting for finish painting to match ceiling.
 4. Acoustical Concealed Spline Ceilings: 24" x 24", Milcor Style AT, 16 gauge steel frame with an 18-gauge steel recessed door panel. 24" x 24" and larger panels shall be reinforced, continuous hinge, cylinder lock, prime painted for finish painting.
- D. Wall Access Panels
1. Drywall: 24" x 24", Milcor Style DW, 16 gauge steel frame with 14-gauge door panel, double acting concealed spring hinges, cylinder lock, prime painted for finish painting with wall.
 2. Masonry and Tile: 24" x 24", Milcor Style M Standard, 14 gauge steel frame and door panel, concealed spring hinges, cylinder lock, prime painted for finish painting with wall or Style M stainless.
 3. Fire-Rated: 24" x 24", Milcor fire-rated access door, UL approved, 1-1/2 hour, Class B rating, 16 gauge steel frame, 20 gauge insulated door panel continuous hinge, automatic door closer, cylinder lock, interior release mechanism, prime painted for finish painting with wall.
 4. Plaster: 24" x 24", Milcor Style K, 16 gauge steel frame with 14 gauge door panel and 22 gauge galvanized casing beads, concealed spring hinges, cylinder lock, prime painted for finish painting with wall.

2.12 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access panels.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures, duct work, piping, and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. All penetrations through Fire-rated enclosures.
7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger. Include proposed elevation of conduits and raceways.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations. Include elevation of fixtures and devices.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines. Include mounting elevations.
8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 - b. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - c. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - d. All penetrations through Fire-rated enclosures.
9. Review: Engineer will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make changes as directed and resubmit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Sleeves

1. Furnish and install sleeves for all penetrations through masonry and concrete construction, smoke or fire rated separations, and equipment room walls and floors.
2. Carefully coordinate and check locations of sleeves immediately before and after each concrete pour and masonry installation.
3. Give the General Trades Contractor locations and sizes of all openings required for the installation of sleeves before construction of masonry or concrete walls is started. If it becomes necessary to cut into new work because of the failure of this Contractor to notify the General Trades Contractor,

then the General Trades Contractor shall do any necessary cutting and patching required at this Contractor's expense.

4. Cut sleeves through walls flush with each surface. Unused sleeves shall extend beyond wall surface, filled with and surrounded by fire barrier materials, and be provided with caps.
5. Cut sleeves 2 inches above finished floors and 3 inches above floors in equipment rooms and shafts. Bottom of sleeve to be cut flush.
6. Core drill holes for sleeves in existing construction.
7. Patching shall be by the General Trades Contractor at this Contractor's expense.
8. Sleeves must be installed plumb with respect to wall.
9. Pack the space between sleeves and conduits or cables with approved fire barrier sealant to maintain fire rating of structure. Fill space around all sleeves leading into exposed areas with material compatible with adjacent construction and finish or fire barrier sealant material to maintain fire rating of the structure.

B. Seals and Firestops

1. Clean surfaces and substrates of dirt, oil, loose materials and other foreign materials which may affect the proper bond or installation of seals and firestops.
2. Do not apply seals and firestops to surfaces previously painted or treated with a sealer curing compound or similar product. Remove coatings as required in compliance with manufacturer's instructions. Provide primers, as required, which conform to manufacturer's recommendations for various substrates and conditions.
3. Follow manufacturer's written instructions for installation of seals and firestops.
4. Install firestops with sufficient pressure to fill seal holes, voids and openings to ensure an effective smoke seal and to maintain the fire resistance rating of the assembly.
5. Tool or trowel exposed surfaces. Remove excess firestop material promptly as work progresses and upon completion.
6. Unused sleeves shall be filled with and surrounded by firestop material. Sleeve ends shall be capped. Blind sealing plugs may be used at Contractor's option.
7. Install watertight seals for all below grade penetrations of conduit into the building.
8. Install fire rated seals in all fire rated walls and floors.
9. Install oil resistant service seals in environment where oils, fuels, solvents and other petroleum - base products are used.
10. Install corrosive service seals in environments where organic materials, acids, alkalis and related chemicals are used.

C. Concrete

1. Provide concrete compression testing for light pole foundations and exterior equipment pads.
2. Do not mount equipment on concrete supports until concrete has had sufficient setting time (seven days minimum).

D. Access Panels

1. Coordinate locations and installation of panels required to permit convenient access to electrical equipment requiring adjustment, service or maintenance. Mark locations of access panels on Record Drawings

3.2 FIELD QUALITY CONTROL

- A. Examine seals and firestops to ensure proper installation and full compliance with this specification. Work shall be accessible until inspection and approval by the applicable code authorities.
- B. Correct unacceptable seals and firestops and provide additional inspection to verify compliance with this specification at no additional cost to the owner.

END OF SECTION 26 00 20

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. Alpha Wire.
 - 3. Belden Inc.
 - 4. Encore Wire Corporation.
 - 5. General Cable Technologies Corporation.
 - 6. Okonite
 - 7. Southwire Incorporated.
- B. **Aluminum and Copper** Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation:
 - 1. Type THW-2
 - 2. Type THHN-2-THWN-2
 - 3. Type XHHW-2
- D. Multiconductor Cable:
 - 1. Type MC metal-sheathed cable, with ground wire.
 - 2. Type MI nonmetallic-sheathed cable,

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. Gardner Bender.
 - 3. Hubbell Power Systems, Inc.
 - 4. Ideal Industries, Inc.
 - 5. IlSCO; a branch of Barden Corporation.
 - 6. NSI Industries LLC.

7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.

- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. 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.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Wire size shall meet or exceed the overcurrent device ampacity as required by NFPA 70. Where wire size shown on drawings is larger than the apparent ampacity requirements the size shown should prevail to account for voltage drop. The minimum conductor size shall be #12 AWG except for control wiring, which may be #14 AWG.
- B. Conductors: Copper, solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Conductors: Aluminum feeders may be utilized for No. 4 AWG and larger, only. Copper for feeders and branch circuits smaller than No. 4 AWG. Solid conductors for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance may utilize the following:
1. Type THHN-2-THWN-2, single conductors in raceway
 2. Type XHHW-2, single conductors in raceway
 3. Mineral-insulated, metal-sheathed cable, Type MI
 4. Type SE
- B. Exposed Feeders may utilize the following:
1. Type THHN-2-THWN-2, single conductors in raceway
 2. Type XHHW-2, single conductors in raceway
 3. Metal-clad cable, Type MC
 4. Mineral-insulated metal-sheathed cable Type MI.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace:
1. Type THHN-2-THWN-2, single conductors in raceway
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground:
1. Type THHN-2-THWN-2, single conductors in raceway
 2. Type XHHW-2, single conductors in raceway
- E. Feeders in Cable Tray:
1. Type TC-ER tray cable, single or multiple conductor,
 2. Mineral-insulated, metal-sheathed cable, Type MI

- F. Exposed Branch Circuits, Including in Crawlspace:
 - 1. Type THHN-2-THWN-2, single conductors in raceway
 - 2. Metal-clad cable, Type MC
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions:
 - 1. Type THHN-2-THWN-2, single conductors in raceway
 - 2. Metal-clad cable, Type MC
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground:
 - 1. Type THHN-2-THWN-2, single conductors in raceway
 - 2. Type XHHW-2, single conductors in raceway

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. MC Cable may be used for branch circuiting to wiring devices provided it is supported properly and run taut. MC must transition to other approved wire types prior to leaving the room it is permitted in. MC may not be used for home-runs.
- B. MC Cable may be used for lighting fixture whips, no longer than 6'-0" and shall be properly supported.
- C. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- D. All feeder and branch circuits shall be ran with dedicated neutral conductors (shared neutrals not permitted).
- E. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- F. 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.
- G. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- H. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- I. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- J. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

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-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

- A. Contractor shall perform insulation resistance (IR) tests, commonly called "megger" tests on any feeder or circuit which may have been damaged during installation or where identified as questionable by the Architect or Engineer. Test shall be performed according to standards published by ANSI/NETA.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services 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.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 05 19

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.2 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Instructions for periodic testing and inspection of grounding features.
 - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Comply with UL 467 for grounding and bonding materials and equipment.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Burndy; Part of Hubbell Electrical Systems.
 2. Dossert; AFL Telecommunications LLC.
 3. ERICO International Corporation.
 4. Fushi Copperweld Inc.
 5. Galvan Industries, Inc.; Electrical Products Division, LLC.
 6. Harger Lightning and Grounding.
 7. ILSCO.
 8. Newton Instrument Company.
 9. O-Z/Gedney; A Brand of the EGS Electrical Group.
 10. Robbins Lightning, Inc.
 11. Siemens Power Transmission & Distribution, Inc.

2.2 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable unless otherwise required by applicable Code or authorities having jurisdiction. Conductors shall be identified by green insulation or by applying green tape at accessible locations.
- B. Bare Copper Conductors: Copper or tinned wire solid or stranded conductors.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, minimum 1/4" by 4 inches by 20 inches and, with 3/8-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.3 CONNECTORS

- A. UL Listed and acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad, 3/4 inch by 10 feet. Provide sectional ground rods as needed.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- B. Grounding Bus: Install in electrical equipment rooms, telecom rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

C. 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 all other Ground Rods: Exothermic welded connectors.
5. Connections to Structural Steel: Exothermic welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Grounding electrode shall include, at a minimum, driven rod(s), metallic water piping system, concrete encased reinforcing steel, and structural steel. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

- A. In addition to the complete metal conduit system, install insulated equipment grounding conductors with all feeders and branch circuits. Minimum equipment grounding conductor size shall be #12 AWG.
- B. 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.
- C. Metallic Fences: Comply with requirements of IEEE C2.
1. Grounding Conductor: Bare copper, not less than No. 6 AWG.
 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 3. Barbed Wire: Strands shall be bonded to the grounding conductor.
- D. Motor frames shall be bonded to the equipment grounding system by an independent ground wire, sized to match the equipment grounding conductor.

3.4 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: On 480V systems with ground-fault protection at the main overcurrent device, install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor, to the frame of the generator, and bonded to the generator system neutral conductor. On 208V systems without ground-fault protection at the main overcurrent device, install ground rod at the generator location. The ground rod shall be connected to the frame of the generator with #6 AWG copper supplemental grounding electrode.
- B. Pad-Mounted Transformers: Install grounding electrode. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to grounding electrodes. Bond the high voltage neutral, cable shields, conduits, and low voltage neutral.

3.5 INSTALLATION

- A. 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.

- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 6 inches below finished floor or 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.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260581 "Manholes, Handholes, and Underground Pull Boxes," and shall be at least 12 inches deep, with cover.
 - 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. 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.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
- F. 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; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. 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.
- G. 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 70 feet apart.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 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.
- B. Tests and Inspections:
 - 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, at ground test wells. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer 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.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 1. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: **5 ohms**.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include 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.

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RGC: Rigid Galvanized Conduit.

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

1.4 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

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. 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. Allied Tube & Conduit.
 - b. Eaton's B-Line Series – Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Atkore International.

- g. Wesanco, Inc.
- 2. Supports shall be hot-dip galvanized after fabrication and applied according to MFMA-4.
- 3. Where installed outdoors or subject to corrosion stainless steel supports shall be provided.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. 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.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless 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.

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. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Raceway Support Methods: In addition to methods described in NECA 1, metallic raceways may be supported by openings through structure members, as permitted in NFPA 70.

- B. 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick. Powder-actuated fasteners may not be used in occupied buildings.
 6. To Steel: Welded threaded studs with lock washers and nuts, Beam clamps, or Spring-tension clamps.
 7. To Light Steel: Sheet metal screws.
 8. 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.

3.3 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.
- B. Use 3000-psi, 28-day compressive-strength 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.

3.4 PAINTING

- A. Touchup: 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.
 2. See additional requirements where painting specification are included as part of this project.
 3. Where finish painting is not included in the general trades contract, or when the Electrical Contractor is the sole contractor, provide prime coat and two finish coats of paint to all ferrous metal which is not galvanized.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780 / A780M.

END OF SECTION 26 05 29

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Floor boxes and poke-thru devices.

1.2 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. FMC: Flexible Metal conduit.
- C. RGC: Rigid galvanized threaded steel conduit.
- D. HDPE: High Density Polyethelene.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquid-Tight Flexible metal conduit.
- G. RNC: Rigid Nonmetallic Conduit.

1.3 ACTION SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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."

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. Anamet Electrical, Inc.
4. Carlon
5. Cantex
6. Champion
7. Electri-Flex Company.
8. O-Z/Gedney.
9. Picoma Industries.
10. Republic Conduit.
11. Robroy Industries.
12. Southwire Company.
13. Thomas & Betts Corporation.
14. Western Tube and Conduit Corporation.
15. Wheatland Tube Company.

- B. Listing and Labeling: Conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CONDUIT TYPES - APPLICATIONS AND RESTRICTIONS:

- A. RGC: Comply with ANSI C80.1 and UL 6.
1. Not to be used in corrosive atmospheres.
- B. IMC: Comply with ANSI C80.6 and UL 1242.
1. Not to be used in corrosive atmospheres.
- C. PVC-Coated Steel Conduit: PVC-coated RGC, IMC. Comply with NEMA RN 1. Coating thickness 0.040 inch, min.
1. For use in utility tunnels and other corrosive atmospheres.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
1. For use in utility tunnels and other corrosive atmospheres.
 2. Not to be used in contact with concrete
- E. RTRC Fiberglass: Comply with UL 1684A and NEMA TC 14.

1. For use underground, direct buried or encased in concrete.
 2. For use in utility tunnels or corrosive atmospheres.
- F. RNC: Type PVC Schedule 40, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
1. For use underground, direct buried or encased in concrete.
- G. EMT: Comply with ANSI C80.3 and UL 797.
1. Not to be used underground or where exposed to weather.
 2. Not to be used in utility tunnels or corrosive atmospheres.
- H. FMC: Comply with UL 1; zinc-coated steel or aluminum.
1. For use with fixture whips and lighting fixtures (6' max).
 2. For connections to dynamic equipment and connections to motors in airstream.
 3. For use in existing walls.
- I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
1. For use under raised floors.
 2. For connections to motors except where protection from physical damage is needed (in air stream).
 3. For use in wet locations.
- J. Rigid HDPE: Comply with UL 651A.
1. For use underground, direct buried, or where directional drilling is permitted.
- K. ENT: Comply with NEMA TC 13 and UL 1653.
1. For use with telecommunications cabling and fiber optic cable, indoors where not exposed to physical damage.

2.3 CONDUIT FITTINGS:

- A. Manufacturers: Subject to compliance with requirements, provide products equal to one of the following.
1. Appleton
 2. Eaton (Crouse Hinds)
 3. Efcor
 4. Steel City
 5. T&B
 6. By Raceway Manufacturer
 7. or equal.
- B. Metallic fittings shall comply with NEMA FB 1 and UL 514b.
- C. All fittings shall be UL listed for the application.
- D. RGC, ARC, and IMC
1. Conduit Fittings for Hazardous (Classified) Locations: Threaded, comply with UL 886 and NFPA 70. Provide seal-off's where raceway enters hazardous location.
 2. Threaded fittings, malleable iron, with grounding bushing. Cooper Industries #800 series, or equal.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- E. RTRC and RNC (PVC)
1. Fittings shall be of the same material and manufacturer as the raceway, solvent welded type.
 2. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. EMT:

1. Steel fittings, setscrew type, insulated throats, concrete tight. Cooper Industries #450 series, or equal.
- G. FMC:
 1. Non-insulated, malleable iron, clamp type. Cooper industries #700 series or equal
- H. LFMC:
 1. Steel or malleable iron. Cooper Industries Liquidator series, LTK series, or equal.
- I. ENT:
 1. Comply with NEMA TC 3; match to conduit or tubing type and material.
- J. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and include flexible external bonding jumper.
- K. Joint Compound for RGC, IMC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.
- L. Solvent cements and adhesive primers 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."

2.4 CONDUIT SIZES

- A. Minimum Raceway Size 3/4-inch trade size.

2.5 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
 1. Cooper B-Line, Inc.
 2. Hoffman.
 3. Mono-Systems, Inc.
 4. Schneider Electric - Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, unless otherwise indicated, and sized according to NFPA 70.
 1. Metal wireways installed outdoors shall be NEMA 3R, listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type, unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.6 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design product.
 - a. Mono-Systems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard custom colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the Drawings, this shall be considered the Basis-of-Design product.
 - a. Hubbell Incorporated.
 - b. Mono-Systems, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.

2.7 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
 - 1. Adalet.
 - 2. Eaton
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. FSR Inc.
 - 6. Hoffman.
 - 7. Hubbell Incorporated.
 - 8. Kraloy.
 - 9. Milbank Manufacturing Co.
 - 10. Mono-Systems, Inc.
 - 11. O-Z/Gedney.
 - 12. RACO; Hubbell.
 - 13. Robroy Industries.
 - 14. Spring City Electrical Manufacturing Company.
 - 15. Stahlin Non-Metallic Enclosures.
 - 16. Thomas & Betts Corporation.
 - 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A. Boxes shall be galvanized or plated finish.
- D. Cast-Metal Outlet and Device Boxes: For use in surface mounted applications. Comply with NEMA FB 1, Type FD, with gasketed cover.

- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- F. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
 - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Device Box Dimensions: 4 inches square or octagonal by 2-1/8 inches deep. Provide extension rings as required for recessed boxes.
- J. Gangable boxes are prohibited.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 for indoor application, Type 3R for outdoor applications (unless otherwise noted on drawings), with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:
 - 1. NEMA 250, Type 1 for indoor application, Type 3R for outdoor applications (unless otherwise noted on drawings), 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.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. PVC Externally Coated, Rigid Steel Conduits: Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
- B. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- C. Install surface raceways only where indicated on Drawings.
- D. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F .
- E. Do not utilize non-ferrous conduit systems or raceway components for motor circuit conductors for variable speed drives. All portions of VFD raceway systems shall be comprised of ferrous materials and provide a continuously grounded pathway to prevent unintentional RF emissions from motor circuit cables.

- F. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- G. 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.
- H. Complete raceway installation before starting conductor installation.
- I. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- J. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- K. Conduit shall be run overhead unless specifically shown on drawings to run under the slab.
- L. Conceal raceways within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- M. Support conduit within 12 inches of enclosures to which attached.
- N. Raceways Installed Below Slabs:
 - 1. Where feeders and branch circuits are permitted to run below slabs they should be installed in non-metallic conduit and encased in 3" envelope of concrete. Provide 6" layer of over fill above encasement.
 - 2. Conduits shall not be installed above the vapor barrier.
 - 3. Transition from RNC-PVC to RGC or IMC before rising above floor.
- O. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- P. 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.
- Q. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- R. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- S. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- T. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- U. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- V. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

- W. 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. Cap underground raceways designated as spare above grade alongside raceways in use.
- X. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- Y. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, 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 raceway sealing fittings according to NFPA 70.
- Z. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- AA. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground conduit crossing building expansion joints. Maintain grounding continuity. Refer to architectural plans for locations or expansion joints.
- BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
- CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- EE. Locate boxes so that cover or plate will not span different building finishes.
- FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- HH. Floor Boxes and Poke-Thru Devices:
 - 1. Provide dummy cover to protect equipment during construction and concrete pour.
 - 2. Unused openings in floor boxes shall be sealed prior to concrete pour.

3.2 CONDUIT SUPPORT

- A. Secure feeder conduit to basic structural elements with galvanized strap hangers and clamps; use of trapeze type hangers is encouraged for multiple conduits where space will permit. Galvanized metal clamps and screws may be used for attaching and supporting branch circuit conduit. Nonmetallic fasteners shall not be used except plastic inserts may be used in concrete for small conduits.
- B. Vertical conduits shall be supported at each floor by clamps.

3.3 ANCHORS AND FASTENERS

- A. Anchors and fasteners shall be of a type designed and intended for use in the base material to which the material support is to be attached and shall be capable of supporting the intended load and withstanding any associated stresses and vibrations.
- B. In general, screws shall be used in wood, masonry anchors on concrete or brick, toggle bolts in hollow walls, and machine screws, bolts or welded studs on steel.

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Direct-buried conduit, ducts, and duct accessories.
 - 2. Concrete-encased conduit, ducts, and duct accessories.

1.2 RELATED DOCUMENTS

- A. Section 26 05 33 "Raceways and Boxes for Electrical Systems" for commonly used electrical conduit types, fittings, and adhesives.

1.3 DEFINITIONS

- A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 INFORMATIONAL SUBMITTALS

- A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 - 2. Drawings shall be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils.
3. Weight: 18.5 lb/1000 sq. ft.
4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

PART 3 - EXECUTION

3.1 APPLICABILITY

- A. Motor circuit conductors associated with variable frequency drives shall not be installed in non-ferrous raceways below grade unless shielded VFD cables are utilized.

3.2 PREPARATION

- 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. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- 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 as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

3.3 EARTHWORK

- A. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- B. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- C. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" Article in Section 017300 "Execution."

3.4 DUCT INSTALLATION

- A. Install ducts according to NEMA TCB 2.
- 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. Installation Adjacent to High-Temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, perform calculations showing the duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- F. 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. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4 inch .
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- G. 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 Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- H. 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.
- I. Pulling Cord: Install 100-lbf- test nylon cord in empty ducts.
- J. Duct Construction:
 - 1. Excavate trench bottom to provide firm and uniform support for duct bank.
 - 2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
 - 3. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts. Secure separators to earth and to ducts to prevent floating during fill. 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.
 - 4. 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.
 - 5. Elbows: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
 - a. 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.
- K. Concrete Encasement:
 - 1. 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.
 - 2. Concrete Cover: Install a minimum of 3 inches of concrete cover at top and bottom, and a minimum of 3 inches on each side of duct bank.
 - 3. 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 a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
 - 4. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place 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. 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.
 - 5. 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.
 - 6. Place minimum 6 inches of engineered fill above concrete encasement of duct bank.
- L. Direct-Buried Duct Banks:
- 1. 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. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
 - a. Place minimum 3 inches of sand as a bed for duct bank. Place sand to a minimum of 6 inches above top level of duct bank.
- M. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.
- N. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.5 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 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 solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch- long 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.

3.7 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. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL 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 size.
- B. Colors for Exposed Raceways:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Concealed Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."
- D. Snap-Around Labels for Raceways: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action. Provide at all splice or junction boxes and at 30' maximum intervals.
- E. Tape and Stencil for Concealed Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends. Provide legend at 30' maximum intervals.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Write-on, 3-mil thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend. Provide label at each termination point.

- C. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide. Provide at each field splice and termination point.

2.3 FLOOR MARKING TAPE

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches.
- C. 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."
 - 3. Multiple Electric Service Warning: "DANGER – BUILDING IS SERVED BY MULTIPLE ELECTRICAL SOURCES" Followed by a description of location and area with floor plan.
 - 4. Emergency Sources Warning: "DANGER – AN ONSITE EMERGENCY GENERATOR IS LOCATED 'XXX'."

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16-inch-thick for signs up to 20 sq. inches 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 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background. Minimum letter height shall be 3/8 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Apply only to finished surfaces.

- B. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- C. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- D. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. 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.
- B. At each junction box and splice box provide pre-printed self-adhesive labels to identify system, voltage, and/or source panel/circuit numbers.
- C. At each wiring device cover plate provide pre-printed self-adhesive labels to identify source panel/circuit numbers.
- D. 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 the Operation and Maintenance Manual.
- E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting:
 1. Identify system voltage with black letters on an orange background.
 2. Apply to exterior of door, cover, or other access.
 3. For equipment with multiple power or control sources, identify all sources:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- G. Operating Instruction Signs: 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.
- H. Electrical Service Equipment: Electrical service equipment shall be provided with an equipment label identifying the available fault current and date calculation was performed, at the equipment bus.
- I. Multiple Electric Service Warning: Where a building is fed from multiple electrical services a permanent plaque or directory shall be placed at each service disconnect location denoting all other services supplying that building and the area of the building served by each service disconnect, complying with NEC 230.2(E).
- J. Emergency Sources Warning: A warning sign shall be placed at the electrical service equipment identifying type and location of on-site emergency power sources, complying with NEC 700.7.
- K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual.
 1. Labeling Instructions:
 - a. Provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - c. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - g. Substations.
 - h. Emergency system boxes and enclosures.
 - i. Motor-control centers.
 - j. Enclosed switches.
 - k. Enclosed circuit breakers.
 - l. Enclosed controllers.
 - m. Variable-speed controllers.
 - n. Push-button stations.
 - o. Power transfer equipment.

- p. Contactors.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Battery-inverter units.
- s. Battery racks.
- t. Power-generating units.
- u. Monitoring and control equipment.
- v. UPS equipment.

END OF SECTION 26 05 53

SECTION 26 05 81

MANHOLES, HANDHOLES AND UNDERGROUND PULL BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes manholes, handholes, and underground pull boxes.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Perform all work in compliance with ASTM, and applicable requirements of governing agencies having jurisdiction and in accordance with these plans and as specified herein.
- B. Manufacturer Qualifications: Manufacturers of pre-cast manholes shall be firms regularly engaged in manufacturing factory fabricated manholes, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- C. Manholes shall be factory fabricated of reinforced concrete and in conformance with American National Standards Institute (ANSI) C 2, "National Electrical Safety Code (NESC)" and applicable requirements of American Society of Testing Materials (ASTM) C 478, "Specifications for Pre-cast, Reinforced Concrete Manhole Sections." Manhole structure shall be designed in accordance with requirements of the American Association of State Highway and Transportation Officials (AASHTO) publication "Standard Specifications for Highway Bridges." AASHTO H20 highway loading shall apply with 30 percent loading added for impact.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Precast Manholes and Handholes.
 - 1. Oldcastle Precast, Inc.
 - 2. Norwalk Concrete Industries
 - 3. Shea Concrete Products
 - 4. Smith-Midland Corp.
- B. Manhole and Handhole Frames and Covers
 - 1. East Jordan (EJ) Iron Works, Inc.
 - 2. Campbell Foundry Co.
 - 3. McKinley Iron Works
 - 4. Neenah Foundry Co.
- C. Cable Racks
 - 1. Underground Devices Incorporated.
 - 2. Hubbell Power Systems, Inc.
 - 3. Or equivalent.
- D. Pull Boxes.
 - 1. Quazite by Hubbell

2. Syntertech by Oldcastle
3. MacLean Highline
4. GlasMasters

2.2 MATERIALS

A. Pre-cast Manholes and handholes

1. Manhole dimensions shall be 6'x6'x8' minimum inside unless otherwise indicated on the drawings.
2. Handhole dimensions shall be 4'x4'x4' minimum unless otherwise indicated on the drawings.
3. Manhole and handholes shall be pre-cast unit consisting of two interlocking, mating sections, complete with accessory items, hardware, and features as indicated including concrete knockout panels for conduit entrance and sleeve for ground rod.
4. Joint sealant for joints between pre-cast sections shall be continuous extrusion of asphaltic butyl material compounded for the adhesion, cohesion, flexibility, and durability properties required for a permanent seal.

B. Manhole and Handholes Hardware and Accessories

1. Frames and covers shall be cast iron conforming to American National Standards Institute (ANSI) C2, "National Electrical Safety Code," Rule 323, AASHTO H-20 with 30% service factor. Furnish with cast in legend, "Electric", or "Telecom" Cover to frame bearing surfaces machined.
2. Sump frame and grate shall comply with A-A-60005, Type VII (Sump Frame) for frame, Type I (Straight Traffic Frame) for cover. Locate sump at center of manhole directly below the cover.
3. Pulling eyes in walls shall be with rebar fastening insert. Working load embedded in 6 inch, 4,500 pounds per square inch (psi) concrete: 13,000 pounds minimum tension.
4. Bolting inserts for cable stanchions shall be flared, threaded inserts of noncorrosive, chemical resistant, nonconductive thermoplastic material. One-half inch internal diameter by 2 3/4 inches deep, flared to 1-1/4 inch minimum at base. Tested ultimate pull out strength: 12,000 pounds, minimum.
5. Expansion anchors for installation after concrete is cast shall be zinc plated carbon steel wedge type with stainless steel expander clip 1/2 inch bolt size, 5,300 pound rated pull out strength, and 6,800 pound rated shear strength, minimum.
6. Manhole cable support rack: heavy duty non-metallic rack, and support arms on each side wall.
7. Provide duct entry knockouts on each side.
8. Provide radius bell ends on all conduits in manholes.
9. Provisions for grounding. Provide exothermic T weld for 4/0 cable entering manhole from each duct bank. Conductors from each duct bank must be exothermic welded together for a continuous grounding path to the source. Provide 4/0 cable tap from the duct bank T weld to a 3" x 18" x 1/4" ground bar mounted on or near the ceiling of the manhole using standoff insulators. Attach all grounds entering the manhole to the ground bar using listed 2-hole compression lugs, antioxidant compound, bronze bolts and Bellville washers.
10. Refer to manhole and handhole details for further requirements.

C. Underground Pull Boxes

1. Underground pull boxes shall be factory fabricated of fiberglass reinforced polymer concrete. Boxes shall be stackable with minimum dimensions:
 1. 11" W x 18" L x 16" D 17" W x 30" L x 16" D.
2. Covers: Provide heavy duty covers, Tier 15 rated for a service load of 15,000 pounds over a 10-inch square area. Covers shall read "High Voltage", "Electric", or "Telecom" as indicated. Covers shall be secured with stainless steel penta-head bolts.
3. Openings: Openings shall be provided for duct number and size as indicated on plan.

D. Ladder

1. Fiberglass manhole ladder, specifically designed for electrical manhole use. Minimum length equal to the distance from the deepest manhole floor to grade, + 3 feet. Supply one ladder at every manhole.

E. Raceway/Duct Sealing Compound

1. Compound shall be nonhardening, putty like consistency workable at temperatures as low as 35° F. Compound shall not slump at a temperature of 300° F. and shall readily adhere to clean surfaces of plastic ducts, metallic conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and the common metals. Compound shall have no injurious effect on worker's hands and materials.
- F. Extra Materials
1. Furnish the following extra materials matching products installed, packaged with protective covering for storage and with identification labels clearly describing contents.
 2. Cable stanchions, support arms, insulators, and associated fasteners in the quantity of 10 percent of those installed for actual use in this project.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Provide manholes, handholes, and underground pull boxes of sizes, and shapes as indicated. Determine final grading of ducts as influenced by possible adjustments in other utilities and surface features and discovery of underground obstructions before installing manholes, handholes, and underground pull boxes, coordinate with Civil Engineer. Install units plumb and level and with orientation and depth coordinated with arrangement of connecting ducts to minimize bends and deflections required for proper entrances.
- B. Install manholes and handholes in approximate locations shown on plans in accordance with manufacturer's written instructions. Coordinate exact location with other utilities grading, paving and owner's representative.
- C. Duct Entrances to Manholes and Handholes: End bells spaced approximately 10 inches center to center for 5 inch ducts (5" typical or is 4") and varied proportionately for other duct sizes. The change from regular spacing to end bell spacing shall start 10 feet from the end bell and shall be made without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances. Slope ducts away from building, towards manhole.
- D. Drainage: Install drains in bottom of units where indicated. Arrange to coordinate with drainage provisions indicated or specified.
- E. Precast Access: Install access to manhole and handholes through cast iron frame and cover. Use 36" diameter cover except as indicated. Install precast concrete rings and seal with joint sealant as described in Part 2 of this specification. In addition, caulk all seams and joints inside and out. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.
- F. Waterproofing: Apply waterproofing to exterior surfaces of units after concrete has cured at least 3 days. After ducts have been connected and grouted in, and prior to backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after brick mortar has cured at least 3 days.
- G. Field Installed Bolting Anchors: Do not drill deeper than 3 7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.
- H. Manholes provisions for future duct(s) to consist of formed opening(s) with structural steel placed around to permit easy knockout of opening in future.

3.2 INSTALLATION OF PRECAST MANHOLES, HANDHOLES, AND UNDERGROUND PULL BOXES

- A. Install in accordance with ASTM C 891, "Standard Practice for Installation of Underground Precast Concrete Utility Structures," and manufacturer's instructions.
- B. Support units on a minimum 12 inch deep level bed of #8 crushed stone.
- C. Compact backfill as required to set units securely in place. Backfill and grading shall be sloped to drain surface water away from access covers.

3.3 CLEANING AND RESTORATION

- A. Clean all internal surfaces including sump. Remove all foreign material.
- B. All manholes, handholes, and pull boxes shall be field inspected prior to acceptance by the Owner. Contractor shall be responsible for pumping manholes, handholes, and pull boxes to allow access for inspection.

END OF SECTION 26 05 81

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Time Clock.
 - 2. Photoelectric switches.
 - 3. Standalone daylight-harvesting switching controls.
 - 4. Indoor occupancy sensors.
 - 5. Outdoor motion sensors.
 - 6. Lighting contactors.
 - 7. Emergency shunt relays.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which equipment will be attached.
 - 3. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Control modules.
- B. Field quality-control reports.
- C. Sample Warranty: For manufacturer's warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
 - 2. Warranty Period: Two 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TIME CLOCK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Intermatic, Inc.
 - 2. Paragon Time Controls
 - 3. NSi Industries LLC; TORK Products.
- B. Electronic Time Clock: Solid state, programmable, with alphanumeric display; complying with UL 917.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Contact Configuration: single pole, single throw (SPST) or as indicated on the drawings.
 - 3. Contact Rating: 20-A ballast load, 120-/240-V ac. Provide inductive load rated contact where shown on drawings to control motor loads.
 - 4. Programs: Minimum, two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
 - 5. Automatic daylight savings time changeover.
 - 6. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Intermatic, Inc.
 - 2. NSi Industries LLC; TORK Products.
 - 3. Leviton

- B. Description: Solid state, with dry contact rated for 1800-VA, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. 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 the photocell to prevent fixed light sources from causing turn-off.
 - 3. Time Delay: Fifteen second minimum, to prevent false operation.
 - 4. Surge Protection: Metal-oxide varistor.
 - 5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Industries, Inc.; Greengate
 - 2. Hubbell Building Automation, Inc.
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Lutron Electronics Co., Inc.
 - 5. Sensor Switch, Inc.
 - 6. Watt Stopper.
- B. Devices Types: Devices located in stairwells shall be ultrasonic type. All other locations shall be dual-technology (PIR and Ultrasonic) type, unless otherwise noted on drawings or in this specification.
- C. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 - 4. Power Pack: Dry contacts rated for 20-A ballast/driver load at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 - 5. 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.
 - 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 - 7. Bypass Switch: Override the "on" function in case of sensor failure.
 - 8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
- D. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 - 3. Switch Rating:

- a. Line Voltage Units: Not less than 800-VA fluorescent or LED at 120 V, 1200-VA fluorescent or LED at 277 V.
 - b. Low Voltage Units: Suitable for use with relay-based lighting control system. Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack relay.
- E. General Requirements for Sensors: High-bay occupancy sensor, solid-state unit. The unit is designed to operate with the luminaires indicated.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Operation: Turn lights on when coverage area is occupied, and to half-power when unoccupied; with a time delay for turning lights to half-power that is adjustable over a minimum range of 1 to 16 minutes.
 - 3. Continuous Lamp Monitoring: When lamps are dimmed continuously for 24 hours, automatically turn lamps on to full power for 15 minutes for every 24 hours of continuous dimming.
 - 4. Operating Ambient Conditions: 32 to 149 deg F.
 - 5. Mounting: Threaded pipe.
 - 6. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - 7. Detector Technology: PIR.
 - 8. Detector Coverage: User selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet.
 - 9. Accessories: Obtain manufacturer's installation and maintenance kit with laser alignment tool for sensor positioning and power port connectors.
- F. General Requirements for Sensors: Extreme Temperature ceiling-mounted, solid-state, extreme-temperature occupancy sensors with a separate power pack.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application in damp locations.
 - 2. Operation: Turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
 - 3. Operating Ambient Conditions: From minus 40 to plus 125 deg F.
 - 4. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 - 5. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 - 6. 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 cover.
 - 7. Bypass Switch: Override the "on" function in case of sensor failure.

2.4 OUTDOOR MOTION SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greengate
 - 2. NX Lighting Controls, Current Lighting.
 - 3. Leviton.
 - 4. nLight; Acuity Brands Lighting, Inc.
 - 5. Sensor Switch, Inc.
 - 6. Watt Stopper.
- B. General Requirements for Sensors: Solid-state outdoor motion sensors.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Dual-technology type, weatherproof. Comply with UL 773A.
3. Switch Rating:
 - a. Lighting-Fixture-Mounted Sensor: 500-VA LED.
 - b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
4. Voltage: Match the circuit voltage
5. Detector Coverage:
 - a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
 - b. Long Range: 180-degree field of view and 110-foot detection range.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
8. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

2.5 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Allen-Bradley/Rockwell Automation.
 2. ASCO Power Technologies, LP.
 3. Eaton Corporation.
 4. General Electric Company;
 5. Square D.
 6. Siemens
- B. Description: Electrically operated and mechanically held, combination-type lighting contactors complying with NEMA ICS 2 and UL 508.
 1. Current Rating for Switching: Listing or rating consistent with type of load served.
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250, hinged enclosure with HOA switch installed in the door. All control wiring shall be wired through the automatic control position.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 22 AWG. Comply with requirements in Section 260519 "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 Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- 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 systems, and partition assemblies.
- 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.

3.2 WIRING INSTALLATION

- A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- B. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires 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. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Lighting control devices will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within twelve (12) months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two (2) visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.6 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943 "Relay-Based Lighting Controls."
- B. **Train** Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 09 23

SECTION 26 09 43

RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Lighting control panels using mechanically held relays for switching.
 - 2. Networked lighting control panels using control-voltage relays for switching and that are interoperable with BAS.
 - 3. Manual switches and plates.
 - 4. Field-mounted signal sources
 - 5. Cables and wiring
 - 6. Plug-Load receptacle control

1.2 DEFINITIONS

- A. BAS: Building automation system.
- B. IP: Internet protocol.
- C. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- D. PC: Personal computer; sometimes plural as "PCs."
- E. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For each relay panel and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail wiring partition configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of relays.
 - 5. Include diagrams for power, signal, and control wiring.
 - 6. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.

1. Show interconnecting signal and control wiring, and interface devices that prove compatibility of inputs and outputs.
 2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the network protocol.
- B. Qualification Data: For testing agency.
- C. Field quality-control reports.
- D. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- E. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.
- 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. Lighting Control Relays: Equal to ONE (1) percent of amount installed, but no fewer than TWO (2).

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Input signal from field-mounted manual switches, or digital signal sources, shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays.
- B. 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.
- C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

- D. Comply with UL 916.

2.2 PERFORMANCE REQUIREMENTS

2.3 MANUFACTURERS

- A. Source Limitations: Obtain all components, sensors, wall switches, and control panels from single source from single manufacturer. Where specific manufacturer is named on the drawings, this manufacturer shall be the basis-of-design manufacturer.
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Crestron
 - 2. NX Lighting Controls
 - 3. Legrand
 - 4. Leviton
 - 5. Lighting Control & Design (LC&D)
 - 6. Lutron
 - 7. nLight
 - 8. Steinel
 - 9. Watt Stopper
 - 10. Greengate

2.4 LIGHTING CONTROL RELAY PANELS

- A. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.
- B. Lighting Control Panel:
 - 1. A single central enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
 - 2. A vertical barrier separating branch circuits from control wiring.
- C. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
 - 1. Timing Unit:
 - a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
 - b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
 - c. Minimum of FOUR independent schedules, each having TWENTY FOUR time periods.
 - d. Schedule periods settable to the minute.
 - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
 - f. TEN special date periods.
 - 2. Sequencing Control with Override:
 - a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
 - b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.

- c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
 - d. Override control "blink warning" shall warn occupants approximately FIVE minutes before actuating the off sequence.
- 3. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation, including accurate time of day and date.
- D. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating shall be not less than 5 kA. Control shall be three-wire, 24-V ac.
- E. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and photo sensors.
- F. Operator Interface:
 - 1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
 - 2. Log and display relay on-time.
 - 3. Connect relays to one or more time and sequencing schemes.

2.5 NETWORKED LIGHTING CONTROL PANELS

- A. Description: Lighting control panels using mechanically latched relays to control lighting and appliances. The panels shall be capable of being interconnected with digital communications to appear to the operator as a single lighting control system.
- B. Lighting Control Panels:
 - 1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
 - 2. A vertical barrier separating branch circuits from control wiring.
- C. Main Control Unit:
 - 1. Ethernet Communications: Comply with MS Windows protocol. The main control unit shall provide for programming of all control functions of the main and all networked slave lighting control panels including timing, sequencing, and overriding.
 - 2. Compliance with ASHRAE 135: Controllers shall support serial MS/TP and Ethernet IP communications, and shall be able to communicate directly via BAS RS-485 serial networks and Ethernet 10Base-T networks as a native device.
 - 3. Web Server: Display information listed below over a standard Web-enabled server for displaying information over a standard browser.
 - a. A secure, password-protected login screen for modifying operational parameters, accessible to authorized users via Web page interface.
 - b. Panel summary showing the master and slave panels connected to the controller.
 - c. Controller diagnostic information.
 - d. Show front panel mimic screens for setting up controller parameters, input types, zones, and operating schedules. These mimic screens shall also allow direct breaker control and zone overrides.
 - 4. Timing Unit:

- a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
 - b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
 - c. Min. FOUR independent schedules, each having TWENTY FOUR time periods.
 - d. Schedule periods settable to the minute.
 - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
 - f. TEN special date periods.
5. Time Synchronization: The timing unit shall be updated not less than every 24 hour(s) with the network time server.
6. Sequencing Control with Override:
 - a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
 - b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
 - c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
 - d. Override control "blinking warning" shall warn occupants approximately FIVE minutes before actuating the off sequence.
 - e. Activity log, storing previous relay operation, including the time and cause of the change of status.
 - f. Download firmware to the latest version offered by manufacturer.
- D. Standard Control Unit, Installed in All Lighting Control Panels: Contain electronic controls for programming the operation of the relays in the control panel, contain the status of relays, and contain communications link to enable the digital functions of the main control unit. Comply with UL 916.
 1. Electronic control for operating and monitoring individual relays, and display relay on-time.
 2. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation.
 3. Integral keypad and digital-display front panel for local setup, including the following:
 - a. Blink notice, time adjustable from software.
 - b. Ability to log and display relay on-time.
 - c. Capability for accepting downloadable firmware so that the latest production features may be added in the future without replacing the module.
- E. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating shall be not less than 5 kA. Control shall be three-wire 24-V ac or digital control network.
- F. Power Supply: NFPA 70, Class 2, UL listed, sized for connected equipment, plus not less than 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and low-voltage photo sensors.
- G. Operator Interface: At the main control unit, provide interface for a tethered connection of a portable PC running MS Windows for configuring all networked lighting control panels using setup software designed for the specified operating system. Include one portable device for initial programming of the system and training of Owner's personnel. That device shall remain the property of Owner.
- H. Software:
 1. Menu-driven data entry.
 2. Online and offline programming and editing.
 3. Provide for entry of the room or space designation for the load side of each relay.
 4. Monitor and control all relays, showing actual relay state and the name of the automatic actuating control, if any.
 5. Size the software appropriate to the system.

2.6 MANUAL SWITCHES AND PLATES

- A. Push-Button Switches: Modular, momentary contact, for operating one or more relays and to override automatic controls.
 - 1. Match color and style specified in Section 262726 "Wiring Devices."
 - 2. Integral green LED neon pilot light to indicate when circuit is on.
- B. Wall Plates: Single and multigang plates as specified in Section 262726 "Wiring Devices."
- C. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.7 FIELD-MOUNTED SIGNAL SOURCES

- A. Daylight Harvesting Switching Controls: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.
- B. Indoor Occupancy Sensors: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

2.8 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 24 AWG.
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Digital and Multiplexed Signal Cables: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5e for horizontal copper cable.

2.9 PLUG-LOAD RECEPTACLE CONTROL

- A. Control relays shall be suitable for use in controlling plug-load receptacles. Refer to plans for signal sources used to control receptacles.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install cables in raceways, cable trays, and/or cable management devices. Conceal raceway and cables except in unfinished spaces. All wiring shall be accessible.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.

- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.2 PANEL INSTALLATION

- A. Comply with NECA 1.
- B. Install panels and accessories according to NECA 407.
- C. Comply with mounting and anchoring requirements specified in Section 260548 "Seismic Controls for Electrical Systems."
- D. Mount top of trim 72 inches above finished floor unless otherwise indicated.
- E. Mount panel cabinet plumb and rigid without distortion of box.
- F. Install filler plates in unused spaces.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.
- D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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.
- D. Acceptance Testing Preparation:
 - 1. Test continuity of each circuit.
- E. Lighting control panel will be considered defective if it does not pass tests and inspections.

- F. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform, Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION 26 09 43

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Electronic-grade panelboards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 26 05 48 "Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

- C. Panelboard Schedules: For installation in panelboards, schedule shall reflect as-built conditions.

1.4 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. Keys: **Two** spares for each type of panelboard cabinet lock.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. 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.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Comply with UL 67.

1.6 COORDINATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than SEVEN days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.
 - 3. Comply with NFPA 70E.
- B. 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, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: **FIVE** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 05 48 "Seismic Controls for Electrical Systems."
- B. All panelboards shall be rated, listed and labeled for the available short-circuit current by the manufacturer. Provide minimum interrupting rating as shown on the drawings, otherwise a minimum of 22,000 amps (for ratings 100V through 240V) and 42,000 amps (for ratings above 240V).
- C. Enclosures:
 - 1. Provide flush and surface enclosures as described on the drawings. Each enclosure shall be rated for environmental conditions at installed location.
 - 2. Provide NEMA 3R enclosures, at a minimum, where panelboards are installed outdoors.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 4. Finishes:
 - a. Panels and Trim: Steel with factory enamel finish.
 - b. Panel Tubs: Galvanized steel.
 - 5. Locking type doors with concealed hinges
 - 6. Panel tubs shall be 20" wide x 5" deep, minimum.
 - 7. Directory card mounted inside panelboard door inside a transparent card holder.
 - 8. Hinged Front Cover: Entire front trim/cover of panelboard shall be door in door construction with cover/trim hinged to box and with standard door within hinged trim cover. Outer door shall permit full access to the panel interior without removal of the cover from the panel box. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed. Trims shall cover all live parts and shall have no exposed hardware when both doors are closed.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Copper.
 - 2. Neutral bus (where required) shall be supplied separate from ground Bus.
 - 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: copper, or CU/AL bi-metallic type.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 4. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- F. Where used as service equipment, panelboards shall carry a Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

2.2 DISTRIBUTION PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), I-Line Style or comparable product by one of the following:

1. Eaton
 2. GE/ABB
 3. Siemens
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches high, provide two latches, keyed alike.
- C. Where main overcurrent protective devices are called for, devices shall be thermal magnetic trip type.
- D. Branch overcurrent protective devices shall be molded case type circuit breakers.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- F. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 2. External Control-Power Source: 120-V branch circuit.

2.3 FUSIBLE DISTRIBUTION PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), QMB Style or comparable product by one of the following:
1. Eaton
 2. General Electric
 3. Siemens
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches high, provide two latches, keyed alike.
- C. Overcurrent protective devices shall be fusible switches utilizing Class RK1 fuses. Class J fuses shall not be acceptable.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 2. External Control-Power Source: 120-V branch circuit.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), NQ (240V) or NF (480V) Style or comparable product by one of the following:
1. Eaton
 2. General Electric
 3. Siemens

- B. Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- C. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.
- D. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
- E. Provide AFCI type circuit breakers for circuits serving dwelling units, dormitory units, and hotel/motel guest rooms and suites, in compliance with NEC 210.12.

2.5 LOAD CENTERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), QO Style or comparable product by one of the following:
 - 1. Eaton
 - 2. General Electric
 - 3. Siemens
- B. Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- C. Provide AFCI type circuit breakers for circuits serving dwelling units, dormitory units, and hotel/motel guest rooms and suites, in compliance with NEC 210.12.

2.6 ELECTRONIC-GRADE PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), NQ or NF Style or comparable product by one of the following:
 - 1. Eaton
 - 2. General Electric
 - 3. Liebert
 - 4. Siemens
- B. Panelboards: With factory-installed, integral Surge Protective Device (SPD); labeled by an NRTL for compliance with UL 67 after installing SPD. Provide Type II device as specified in section 26 43 13, Surge Protection for Low Voltage Electrical Power Circuits.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- E. Buses:
 - 1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
 - 2. Copper equipment and isolated ground buses.

2.7 FUSIBLE PANELBOARDS

- A. Manufacturers: Subject to compliance with all stated requirements, provide products by one of the following:
 - 1. Littlefuse LCP Series (Basis of Design)
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. SIEMENS Industry, Inc.; Energy Management Division.
 - 4. Square D; by Schneider Electric.
 - 5. Cooper/Bussman
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Factory UL listing
- D. Mains: Circuit breaker or Lugs as identified on drawings.
- E. Buses:
 - 1. Size as indicated on drawings.
 - 2. Copper phase and neutral buses;
 - 3. 200 percent capacity neutral bus and lugs.
- F. Branch Overcurrent Protective Devices: Circuit breaker devices in line with class CC or class J finger safe fuse holder devices.
 - 1. Circuit breakers: Comply with 262823 – Circuit Breakers
 - 2. Fuses / Fuse holders: Provide only products that utilize permanently mounted dead front finger safe fuse holders that open to permit replacement of cartridge type CC or J fuses. Fuse holders shall be provided with blown fuse indication. Provide fuses for all fuse holders provided in the panel. Fuses shall comply with 262813 – Fuses.
 - 3. Products that utilize any of the following types of fuses are prohibited from use on this project:
 - a. Plug on fuse blocks
 - b. Fuse holders or fusing approaches that use other than cylindrical cartridge type class 'CC' or class 'J' fuses.
 - c. Products that require replacement of any components other than cylindrical cartridge type class 'CC' or class 'J' fuses after an overcurrent event on a branch circuit.
- G. Doors: Provide and secure as identified elsewhere in this section

2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state electronic trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

3.2 INSTALLATION

- A. Floor set panelboards shall be installed on concrete bases, 4-inch nominal thickness.
 - 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.
- B. Wall mounted panelboards shall be installed so that the top of the cabinet is 6'-0" above the floor, coordinate panelboard location to avoid interference with other equipment.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Section 26 05 48 "Seismic Controls for Electrical Systems."
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box. Assure door swing does not interfere with other equipment.
- F. Install filler plates in unused spaces.
- G. Where panelboards are to be recessed, stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- I. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- 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.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. 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.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- C. Panelboards will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

- A. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 27 13
ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes equipment for:
 - 1. Electricity metering by utility company
 - 2. Electricity metering non-utility.

1.2 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Application and operating software documentation.
 - 2. Software licenses.
 - 3. Software service agreement.
 - 4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.3 QUALITY ASSURANCE

- A. 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.

1.4 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
 - 1. Comply with requirements of utilities providing electrical power services.
 - 2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Meters will be furnished by utility company.
- B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- C. Meter Sockets: Comply with requirements of electrical-power utility company.
- D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

- E. Modular Meter Center: Factory-coordinated assembly of a main service terminal box with lugs only, wireways, tenant meter socket modules, and tenant feeder circuit breakers arranged in adjacent vertical sections. Assembly shall be complete with interconnecting buses and other features as specified below.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following. Where a specific manufacturer is listed in the drawings, this shall be considered the Basis-of-Design product.
 - a. Eaton
 - b. General Electric
 - c. Siemens
 - d. Schneider Electric (Square D)
 2. Comply with requirements of utility company for meter center.
 3. Housing: Type 3R enclosure.
 4. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers.
 5. Main Disconnect Device: Fusible switch, series-combination rated by circuit-breaker manufacturer to protect downstream feeder and branch circuit breakers.
 6. Tenant Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect circuit breakers in downstream tenant and to house load centers and panelboards that have 10,000-A interrupting capacity.
 - a. Identification: Complying with requirements in Section 26 05 53 "Identification for Electrical Systems" with legend identifying tenant's address.
 - b. Physical Protection: Tamper resistant, with hasp for padlock.
 7. Meter Socket: Rating coordinated with indicated tenant feeder circuit rating.
 8. Surge Protection: For main disconnect device, comply with requirements in Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install modular meter center according to NECA 400 switchboard installation requirements.

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 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.
- B. Tests and Inspections:
 1. Connect a load of known kilowatt rating, to a circuit supplied by metered feeder.
 2. Turn off circuits supplied by metered feeder and secure them in off condition.

3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
 4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
- C. Electricity metering will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 26 27 13

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Receptacles, receptacles with integral GFCI
 - 2. Weather-resistant receptacles.
 - 3. Snap switches.
 - 4. Device cover plates.

1.2 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.4 ACTION SUBMITTALS

- A. Product data: For each type of device and component indicated. Include manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain all wiring devices and associated wall plates from single source from single manufacturer.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper
 - b. Hubbell
 - c. Legrand

- d. Leviton
- e. Lutron
- f. Pass & Seymour

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices shall be side-wired. Devices that use modular plug-in connectors are not acceptable.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 120 volt, 20 amp: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
- B. All convenience and power receptacles shall be Heavy Duty Specification grade grounding type.
- C. Weather resistant Receptacle shall be ultra-violet, corrosion, and impact resistant, with UL approved "WR" marking on face.
- D. Tamper Resistant Receptacles: All 120V and 250V, 15A and 20A, non-locking type receptacles installed in the following locations shall be listed Tamper Resistant, in compliance with NEC 406.12:
 - 1. Dwelling units
 - 2. Guest rooms and guest suites of hotels and motels
 - 3. Child care facilities
 - 4. Preschool and Elementary education facilities
 - 5. Business offices, corridors, waiting rooms in clinics, medical and dental offices and outpatient facilities.
 - 6. Assembly occupancies including gymnasiums, skating rinks, auditoriums, and places of waiting transportation.
 - 7. Dormitories
- E. Specialty receptacles shall be as specified on Drawings.
- F. Plug-Load Control Receptacles: Receptacles shall be permanently marked to visually differentiate them from uncontrolled receptacles.
- G. USB Charging Receptacles: Receptacle shall consist of a tamper-resistant duplex convenience receptacle with one USB-A and one USB-C charge port integral in the face of the receptacle. Device shall supply no less than 24W of charging power.

2.4 GFCI RECEPTACLES

- A. General Description:
 - 1. Straight blade, feed-through type, unless specified otherwise on Drawings.
 - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, and FS W-C-596.
 - 3. Comply with UL 943, device shall be self-testing and provide visual or audible alarm upon ground fault condition.
 - 4. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

- B. Weather resistant Receptacle shall be ultra-violet, corrosion, and impact resistant, with UL approved "WR" marking on face.

2.5 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 volt, 20 amp:
- C. Pilot-Light Switches, 20 amp:
 - 1. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."
- D. Key-Operated Switches, 120/277 volt, 20 amp:
 - 1. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 volt, 20 amp; for use with mechanically held lighting contactors.
- F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 volt, 20 amp; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.6 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces:
 - a. Steel with white baked enamel, suitable for field painting
 - b. 0.035-inch- thick, satin-finished, Type 302 stainless steel
 - c. 0.04-inch- thick, brushed brass with factory polymer finish
 - d. 0.05-inch- thick, anodized aluminum
 - e. High impact smooth nylon in Architect selected finish.
 - 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 and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.7 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect/Engineer 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, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. 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 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 final painting, is complete.
- C. Conductors:
 - 1. 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.
 - 2. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 3. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
 - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 - 2. Do not remove surface protection, such as plastic film and smudge covers, until immediately prior to occupancy.
 - 3. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 - 4. Tighten unused terminal screws on the device.
 - 5. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
 - 1. Devices shall be installed vertically with ground pin up, where explicitly shown to be mounted horizontally, position the ground pin to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening. The use of caulk around device plates to seal gaps shall not be permitted.
- G. Adjust mounting height and location of Devices: Where devices are installed to serve furniture or furnishings, or otherwise located in the vicinity of furniture or furnishings, the mounting height and location of such Devices shall be adjusted to permit full access to the Devices without the need to move furniture or furnishings. Provide proposed modifications of mounting height and locations for each Device to be changed to Engineer for approval prior to rough-in of said Device.
- H. Plug-load controlled receptacles shall be controlled on/off using a time-of-day schedule or local occupancy sensor. Refer to plans for specific control requirements.

3.2 WEATHER RESISTANT RECEPTACLES

- A. All 120 volt, 15 amp and 20 amp receptacles installed in damp or wet locations shall be UL listed as weather-resistant and have "WR" mark on face of receptacle. Receptacles installed outside shall be provided with a weather-proof "in-use" cover.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value over 5 percent is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. 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.
- C. Wiring device shall be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600-V ac and less for use in the following:
 - a. Motor-control centers.
 - b. Panelboards (fusible).
 - c. Switchboards.
 - d. Enclosed switches and controllers.
 - 2. Spare-fuse cabinets.

1.2 CLOSEOUT SUBMITTALS

- 1. Spare Parts Inventory List

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

PART 2 - PRODUCTS

2.1 FUSES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Cooper Bussman or comparable product by one of the following:
 - 1. Cartridge Fuses
 - a. Mersen
 - b. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: Fuses shall be current-limiting with 200,000 Amps interrupting rating and carry a UL label.
 - 1. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting; 600V – LP-CC
 - 2. Type J: 600-V, zero- to 600-A rating, 200 kAIC; 600V – JDL.
 - 3. Type RK1: Thru 600A, 200 kAIC, dual element, time delay; 250V – LPN-RK, 600V – LPS-RK.
 - 4. Type L: Fuses larger than 600A: Class L, dual element, time delay; 600V – KRP-C.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum. Provide multiple cabinets if required to meet storage and spare capacity minimums.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- high red letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.
5. Keys: Provide (2) two keys for each cabinet provided. Multiple cabinets if provided shall be keyed alike.

2.4 SPARE PARTS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses: Equal to 10 percent of the quantity installed for each size and type, but no fewer than two of each size and type.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Within each fusible device, install fuses that are of the same class and rating. Do not mix class or amperage ratings between multiple fuse positions.
- C. Install spare-fuse cabinet(s). Provide wood blocking secured to studs if mounted on a stud wall.

3.2 IDENTIFICATION

- A. Install labels complying with requirements for identification specified elsewhere and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Disconnect switches.
 - 2. Molded-case circuit breakers (MCCBs).
 - 3. Molded-case switches.
 - 4. Shunt trip switches.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

1.4 ACTION SUBMITTALS

- A. 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, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- C. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.7 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- 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.
- D. 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.
- E. Comply with NFPA 70.

1.9 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.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven (7) days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

1.10 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. Eaton
 - 2. GE/ABB
 - 3. Siemens
 - 4. Schneider Electric (Square D).
- B. Type HD, heavy duty, fusible and non-fusible, disconnect switches. Switches shall be horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. 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; labeled for copper and aluminum neutral conductors.
 - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 4. Auxiliary Contact Kit: NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 5. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 6. Service-Rated Switches: Labeled for use as service equipment.
 - 7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac, unless noted otherwise.

2.2 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. Cooper Bussmann, Inc.
 - 2. Ferraz Shawmut, Inc.
 - 3. Littelfuse, Inc.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses.
- E. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight green ON pilot light.
 - 3. Isolated neutral lug;
 - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 5. Form C alarm contacts that change state when switch is tripped.
 - 6. Three-pole, double-throw, fire-safety and alarm relay; suitable for 120-V ac or 24-V dc coil voltage.
 - 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), or comparable product by one of the following:
 - 1. Eaton
 - 2. General Electric
 - 3. Siemens
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. 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 larger than 100 A.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

- G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- I. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
 - 6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 7. Undervoltage [and Phase Loss Detection](#) Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - 9. Alarm Switch: One NO NC contact that operates only when circuit breaker has tripped.
 - 10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - 11. Zone-Selective Interlocking: Integral with trip unit; for interlocking ground-fault protection function.
 - 12. Electrical Operator: Provide remote control for on, off, and reset operations.
 - 13. Accessory Control Power Voltage: Integrally mounted; 120-V ac, unless noted otherwise.

2.4 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
 - 1. Eaton
 - 2. General Electric
 - 3. Siemens
 - 4. Schneider Electric (Square D).
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Features and Accessories:
 - 1. Standard frame sizes and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 5. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
 - 6. Alarm Switch: One NO NC contact that operates only when switch has tripped.
 - 7. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.

8. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
9. Electrical Operator: Provide remote control for on, off, and reset operations.
10. Accessory Control Power Voltage: Integrally mounted, 120-V ac, unless noted otherwise.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Kitchen Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Section 260548-16 "Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.

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.
- D. Acceptance Testing Preparation:
1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- E. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 26 28 16

SECTION 26 29 13
ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage manual motor starters
 - 2. Full-voltage magnetic motor starters

1.2 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7**.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified **and the unit will be fully operational after the seismic event.**"

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Field quality-control reports.
- D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.5 MATERIALS MAINTENANCE 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. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Indicating Lights: Two of each type and color installed.
 - 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. 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.
- C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric (Square D), or comparable product by one of the following:
 - 1. Eaton
 - 2. GE/ABB
 - 3. Siemens

2.2 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Configuration: Nonreversing.
 2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2; heaters matched to nameplate full-load current of actual protected motor; external reset push button; melting alloy type.
 3. Flush devices where installed in finished spaces, otherwise surface mounting.
 4. Red pilot light.
- C. Magnetic Controllers: Full voltage, across the line, electrically held.
1. Configuration: Nonreversing.
 2. Contactor Coils: Pressure-encapsulated type.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 3. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 4. Control Circuits: **120V** ac.
 5. Integral CPT, with primary and secondary fuses, of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 6. Melting Alloy Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 7. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running overload protection.
 - b. Sensors in each phase.
 - c. Selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 8. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
 9. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate **Class R** fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 10. Nonfusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 11. Auxiliary Devices: Provide heavy duty pushbuttons, LED pilot lights to indicate motor status, and Hand-Off-Auto (HOA) rotary switch. All devices shall be factory mounted in enclosure cover.

2.3 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 - 1. Provide NEMA 1 enclosures for indoor dry environments. Where located outdoors, or in wet environments provide NEMA 3R enclosures, unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

3.2 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.3 CONTROL WIRING INSTALLATION

- A. Bundle, train, and support wiring in enclosures.
- B. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 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.
- D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. **Test and adjust controllers, components, and equipment.**
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages.
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multi-pole enclosed controller 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

3.6 DEMONSTRATION

- A. **Engage a factory-authorized service representative to train, Train** Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 26 29 13

SECTION 26 43 13

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes field-mounted Surge Protective Devices (SPDs) for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Refer to the following specification sections for Surge Protective Devices which are to be factory installed in equipment.
 - 1. 26 23 00 – Switchgear
 - 2. 26 24 13 – Switchboards
 - 3. 26 24 16 – Panelboards

1.2 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

- B. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For SPDs to include in maintenance manuals.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion, unless listed otherwise in the following paragraphs.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Where surge protective device is shown attached to an automatic transfer switch or other equipment without integral overcurrent protective devices, provide surge protective device with integral disconnect switch.
- D. Provide device in powder coated, impact resistant steel enclosure. Where shown to be installed outdoors, provide weatherproof NEMA 3R enclosure.

2.2 SPD FOR SERVICE EQUIPMENT AND SWITCHBOARDS.

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Joslyn by Thomas & Betts (JSP-240) or comparable product by one of the following:
 - 1. Eaton
 - 2. Emerson
 - 3. GE
 - 4. Schneider Electric
 - 5. Siemens
- B. Provide UL 1449, Type I devices suitable for the voltage shown on the drawings.
- C. Surge capacity of 240,000A per phase, 120,000A per mode, fully rated (SCCR) of 200KAIC, with TEN modes of protection (L-L, L-G, L-N, N-G). Each mode shall be protected with individually fused MOVs. Nominal discharge current (I-n) shall be 20,000A.
 - 1. SPDs with the following features and accessories:
 - a. Indicator light display for protection status.
 - b. Surge counter.
 - c. Transient Filter complying with UL 1283 for electromagnetic interference.
 - d. Form-C contacts (1 N.O, 1 N.C.), for remote monitoring of protection status.

2.3 SPD FOR DISTRIBUTION EQUIPMENT

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Joslyn by Thomas & Betts (JSP-120) or comparable product by one of the following:
 - 1. Eaton
 - 2. Emerson
 - 3. GE
 - 4. Schneider Electric
 - 5. Siemens
- B. Provide UL 1449, Type 2 devices suitable for the voltage shown on the drawings.
- C. Surge capacity of 120,000A per phase, 60,000A per mode, fully rated (SCCR) of 100KAIC, with TEN modes of protection (L-L, L-G, L-N, N-G). Each mode shall be protected with individually fused MOVs. Nominal discharge current (I-n) shall be 20,000A.
 - 1. SPDs with the following features and accessories:
 - a. Indicator light display for protection status.
 - b. Surge counter.
 - c. Transient Filter complying with UL 1283 for electromagnetic interference.
 - d. Form-C contacts (1 N.O, 1 N.C.), for remote monitoring of protection status, where indicated on drawings.

2.4 SPD FOR PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Joslyn by Thomas & Betts (TransEnd 50) or comparable product by one of the following:
 - 1. Eaton
 - 2. Emerson
 - 3. GE
 - 4. Schneider Electric
 - 5. Siemens
- B. Provide UL 1449, Type 2 devices suitable for the voltage shown on the drawings.
- C. Surge capacity of 100,000A per phase, 50,000A per mode, fully rated (SCCR) of 65KAIC, with TEN modes of protection (L-L, L-G, L-N, N-G). Each mode shall be protected with individually fused MOVs. Nominal discharge current (I-n) shall be 20,000A.
 - 1. SPDs with the following features and accessories:
 - a. Indicator light display for protection status.
 - b. Metallic flexible conduit whip.
 - c. Transient Filter complying with UL 1283 for electromagnetic interference.
 - d. Form-C contacts (1 N.O, 1 N.C.), for remote monitoring of protection status, where indicated on drawings.

2.5 SPD FOR SINGLE-PHASE LOADS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Joslyn by Thomas & Betts (Surgitron III) or comparable product by one of the following:
 - 1. Eaton
 - 2. Emerson
 - 3. GE

4. Schneider Electric
 5. Siemens
- B. Provide UL 1449, Type 2 devices suitable for the voltage shown on the drawings.
- C. Surge capacity of 40,000A per phase, fully rated (SCCR) of 50 KAIC, with all modes of protection. Each mode shall be protected with individually fused MOVs.
1. SPDs with the following features and accessories:
 - a. Indicator light display for protection status.
 - b. Metallic flexible conduit whip.
 - c. Three year warranty.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 22 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
1. Compare equipment nameplate data for compliance with Drawings and Specifications.
 2. Inspect anchorage, alignment, grounding, and clearances.
 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.

- C. Prepare test and inspection reports.
 - 1. Final test and inspection reports shall document the quantity of surges recorded on all SPD surge counters at the completion of the testing, and the date that the observation was made.

3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 26 43 13

SECTION 26 51 19
LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for LED luminaires indicated in the Luminaire Schedule on the drawings.
- B. Luminaire supports.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests IES LM-79 and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 - 7. LED driver or power supply product data sheets for each luminaire.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.
4. Where specifically indicated on plans, include photometric PxP drawings for areas where alternate fixtures are supplied.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Certificates: For each type of luminaire.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
1. One (1) copy of each approved submittal.
 2. Certificate of Material Receipt.

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. Drivers: TEN percent of each type and rating installed. Furnish at least one of each type.
 2. Diffusers and Lenses: ONE percent of each type and rating installed. Furnish at least one of each type.
 3. Globes and Guards: ONE percent of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.
- B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- C. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
1. Obtain Architect's approval of luminaires in mockups before starting installations.
 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect 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.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: FIVE year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."
- A. Provide Luminaires as scheduled on the Drawings.
- B. Provide luminaires with integral thermal protection.
- C. LED luminaire shall be modular in design with the ability to replace individual components (LED Modules, drivers, etc.) without having to replace the entire luminaire.
- D. All LED luminaire shall have a minimum CRI of 80.
- E. Unless specifically indicated otherwise per the luminaire schedule, all LED lamp CCT shall be 4000K.
- F. LED/LED Module and driver shall be rated for a minimum of 50,000 hours of life at 80% output (LM-80).
- G. For each type Luminaire, the LED/LED Module shall originate from a common manufactured batch source.
- H. All LED/LED Module shall adhere to LED package manufacturer guidelines, certification programs, and test procedures for thermal management.
- I. Driver shall be FCC Part 15 compliant, UL 8750.
- J. Driver shall meet ANSI C62.41 category A surge protection standards up to 4kV.
- K. All LED drivers shall have a power factor greater than 0.90.
- L. Emergency LED battery pack shall be integral mounted, ninety (90) minute capacity, sealed maintenance free nickel cadmium battery and integral charger, operate at rated lumen output of fixture or next highest lumen output available providing no less than 50% of the standard lumen output, and have remote mountable charging indicator light and test switch. LED drivers shall feature a self-diagnostic circuit that automatically tests unit and reports failure with an audible and visual alarm.
- M. Ambient Temperature: Indoor Luminaires, 41 to 104 deg F.; Outdoor Luminaires, 5 to 104 deg F.

1. Relative Humidity: Zero to 95 percent.

2.2 LUMINAIRE REQUIREMENTS

- A. 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.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. California Title 24 compliant.

2.3 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "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 minimum diameter steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 14 AWG. Min.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

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. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Regardless of locations shown or mounting heights indicated on drawings, do not rough or install luminaires in locations where they conflict with existing or new equipment. Luminaires that are installed in locations or heights that conflict with the work of other trades, or conflict with the operation or maintenance requirements of equipment shown in the construction drawings shall be relocated as required to resolve such conflicts at the contractor's expense.
- D. Install lamps in each luminaire.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Flush-Mounted Luminaires:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- G. Wall-Mounted Luminaires:
 - 1. Where recommended by luminaire manufacturer, attach to structural members in walls. Otherwise mount fixture to back box.
 - 2. Do not attach luminaires directly to gypsum board.
- H. Suspended Luminaires:

1. Ceiling Mount:
 - a. Provide quantity of stems or adjustable aircraft cable to support suspended fixtures as described in the luminaire schedule and manufactures installation instructions.
 2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 4. Continuous Rows of Luminaires: Use stems, rod, or aircraft cable support as indicated in luminaire schedule, for suspension of each unit length of luminaire chassis, including one at each end. Maximum span shall not exceed 12'.
 5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
 6. Use of strut or other means to group mount luminaires are prohibited in space types as noted below. Luminaires in these locations noted below shall be individually mounted unless specifically noted on drawings to be group mounted:
 - a. Electrical rooms
 - b. Mechanical rooms
- I. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 3. Use approved devices and support components to connect luminaire to ceiling grid in a minimum of four locations, spaced near corners of luminaire.
 4. Do not use ceiling grid as support for luminaires. Support with aircraft cable or similar wire from building structure from a minimum of TWO locations, independent of the ceiling system.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."

- B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.7 ADJUSTING

- A. Adjustments after installation: Prior to project completion but after all luminaires have been completely installed, meet on site with the A/E to review the installation and setup of all lighting fixtures supplied on the project. Review each unique fixture type and condition installed on the project. Make proper adjustments to each luminaire as required for function and operation as intended by the A/E. Such work shall include but not be limited to:
1. Making minor adjustments to the heights of cable suspended luminaires as required for plumbness, coordination of installation heights with field conditions, or to address discomfort glare from illumination sources.
 2. Opening each luminaire and adjusting trim potentiometers, dip switches, or other adjustable elements that may control the output level, color temperature, network address, or other configurable parameters.
 3. Adjust aiming angles of luminaires as required for operation as intended by the A/E.
- B. Occupancy Adjustments: When requested within TWELVE months of date of Substantial Completion, provide on-site assistance in adjusting luminaires to suit occupied conditions. Make up to TWO visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 3. Open luminaires as requested and adjust trim potentiometers, dip switches, or other adjustable elements that may control the output level, color temperature, network address, or other configurable parameters.
 4. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 51 19

SECTION 26 52 13

EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Emergency lighting units.
 - 2. Exit signs.
 - 3. Luminaire supports.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
 - 1. Include data on features, accessories, and finishes.
 - 2. Include physical description of the unit and dimensions.
 - 3. Battery and charger for light units.
 - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
 - 5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Product Schedule:
 - 1. For all luminaires and exit signs, use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 4. Provide seismic qualification certificate for each piece of equipment.
- B. Product Test Reports: For each luminaire for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

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. Lamps: TEN percent of each type and rating installed. Furnish at least one of each type.
 2. Luminaire-mounted, emergency battery pack: FIVE percent emergency lighting units. Furnish at least one of each type.
 3. Diffusers and Lenses: ONE percent of each type and rating installed. Furnish at least one of each type.
 4. Globes and Guards: ONE percent of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- C. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
1. Obtain Architect's approval of luminaires and signs in mockups before starting installations.
 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect 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.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: TWO year(s) 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 Power Unit Batteries: FIVE years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.
 2. Warranty Period for Self-Powered Exit Sign Batteries: FIVE years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. 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.
- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
 1. Emergency Connection: Operate one lamp or an equivalent number of LED's continuously at an output of no less than 50% of total lumen output upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.
 2. 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.
 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Indoor Luminaires, 41 to 104 deg F.; Outdoor Luminaires, 5 to 104 deg F..
 - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
 - c. Humidity: More than 95 percent (condensing).
 4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire 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.
 - 5. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - 6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 - 7. 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 a flashing red LED.
- F. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
- 1. Emergency Connection: Operate one lamp or an equivalent number of LED's continuously at an output of no less than 50% of total lumen output upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.
 - 2. 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.
 - 3. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - 4. Charger: Fully automatic, solid-state, constant-current type.
 - 5. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.
 - 6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - 7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 8. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - 9. 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 a flashing red LED.

2.3 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Luminaires:
 - 1. Emergency Luminaires: Drawing designation as indicated in the Luminaire Schedule on Drawings, with the following additional features:
 - a. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations. Indoor and outdoor applications as shown on plans.
 - b. UL 94 flame rating.
- C. Emergency Lighting Unit:
 - 1. Emergency Lighting Unit: as indicated in the Luminaire Schedule on Drawings.
 - 2. Operating at nominal voltage matching lighting system.
 - 3. Wall, ceiling, or stem mounted with universal junction box adaptor.
 - 4. UV stable thermoplastic housing.
 - 5. Two LED lamp heads.
 - 6. Internal emergency power unit.
- D. Remote Emergency Lighting Units:
 - 1. Emergency Lighting Unit: as indicated on Drawings.
 - 2. Operating at nominal voltage matching lighting system.

3. Wall, ceiling, or stem mounted with universal junction box adaptor.
4. UV stable thermoplastic housing, provide wet location listing where shown outdoors.
5. LED lamp heads.
6. External emergency power unit.

2.4 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 1. Operating at nominal voltage as shown on plans.
 2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
 3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.
 - a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional battery capacity for power connection to remote units where shown.
- C. Self-Luminous Signs:
 1. Powered by tritium gas, with universal bracket for flush-ceiling, wall, or end mounting. Signs shall be guaranteed by manufacturer to maintain the minimum brightness requirements in UL 924 for 20 years.
 2. Use strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Include universal bracket for flush-ceiling, wall, or end mounting.

2.5 MATERIALS

- A. Metal Parts:
 1. Free of burrs and sharp corners and edges.
 2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.

2.6 METAL FINISHES

- A. 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 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire and emergency power unit weight.
 - 2. Able to maintain luminaire position when testing emergency power unit.
 - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
 - 1. Where recommended by luminaire manufacturer, attach to structural members in walls. Otherwise mount fixture to back box.
 - 2. Do not attach luminaires directly to gypsum board.
- F. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Ceiling Grid Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Perform startup service:
 - 1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.
 - 2. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

- A. Adjustments: Within 12 <twelve> months of date of Substantial Completion, provide on-site visit to do the following:
 - 1. Inspect all luminaires. Replace lamps, emergency power units , batteries, signs, or luminaires that are defective.
 - a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 26 52 13

SECTION 26 56 13

LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Poles and accessories for support of luminaires.
 - 2. Luminaire-lowering devices.

1.2 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete luminaire.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch deep. Do not apply tools to section of pole to be installed below finished grade.
- C. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- D. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) and luminaire-lowering device(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk

due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: FIVE years from date of Substantial Completion.
2. Warranty Period for Corrosion Resistance: FIVE years from date of Substantial Completion.
3. Warranty Period for Color Retention: FIVE years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
 2. Component Importance Factor: 1.0.
- B. Structural Characteristics: Comply with AASHTO LTS-6-M.
- C. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- D. Live Load: Single load of 500 lbf (2200 N) distributed according to AASHTO LTS-6-M.
- E. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.
- F. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.
 1. Basic wind speed for calculating wind load for poles exceeding 50 feet (15 m) in height is 100 mph 90 mph
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 50 years
 - c. Velocity Conversion Factor: 1.0.
 2. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is 100 mph 90 mph
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 25 years.
 - c. Velocity Conversion Factor: 1.0.
- G. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 <Insert number> to obtain the EPA to be used in pole selection strength analysis.
- H. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 METALLIC POLES

- A. Provide poles made of steel or aluminum, round or square, tapered or straight, as described on plans.

- B. Source Limitations: Obtain poles from single manufacturer or producer.
- C. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.
- D. Steel Poles: Comply with ASTM A 500/A 500M, Grade B carbon steel with a minimum yield of 46,000 psig. Where designated as stainless steel, comply with ASTM A 240/A 240M with a minimum yield of 55,000 psig. One-piece construction up to 40 feet in height with access handhole in pole wall.
 - 1. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- E. Aluminum Poles: Seamless, extruded structural tube complying with ASTM B 221, Alloy 6063-T6, with access handhole in pole wall.
 - 1. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- F. Mast Arms: Provide quantity of arms as described in plans, continuously welded to pole attachment plate. Material and finish same as pole.
- G. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 - 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together.
 - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- H. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- I. Fasteners: Stainless or Galvanized steel type, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 - 1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- J. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- K. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- L. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.
- M. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- N. Galvanized Finish Steel: After fabrication, hot-dip galvanize according to ASTM A 123/A 123M.
- O. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Color: As selected by Architect from manufacturer's full range.
- P. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
 - 1. Color: As selected by Architect from manufacturer's full range.

2.3 FIBERGLASS POLES

- A. Poles:
 - 1. Designed specifically for supporting luminaires, with factory-formed cable entrance and handhole.
 - 2. Not less than 65 percent by weight of fiberglass roving, with resin and pigment making up the remainder.
 - 3. Roving shall be continuously applied with uniform tension, with multiple layers placed to meet axial and compressive strength requirements.
 - 4. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
 - 5. Resin Color: As selected by architect; uniform coloration throughout entire wall thickness.
 - 6. Surface Finish: Smooth and uniform along surface of pole.
- A. Mast Arms: Provide quantity of arms as described in plans, continuously welded to pole attachment plate. Material and finish same as pole.
- B. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 - 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together.
 - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- C. Pole-Top Tenons: Steel, hot-dip galvanized according to ASTM A 153, or 6061-T6 aluminum, permanently bonded to the fiberglass shaft. Fabricated to support luminaire or luminaires and brackets indicated.
- D. Fasteners: Stainless or Galvanized steel type, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
 - 1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- E. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- F. Grounding: Bare, stranded copper, #6 AWG, suspended inside of pole, connected to luminaire(s), ground lug near handhole and ground rod.
- G. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- H. Anchor Base: Integral galvanized steel or aluminum casting, enclosing and permanently bonded to the exterior of the fiberglass shaft.

2.4 PRESTRESSED CONCRETE POLES

- A. Poles: Comply with ASTM C 1089.
 - 1. Mounting Provisions: Steel butt flange for bolted.
 - 2. Finishing: Capped at top and plugged at bottom. Seat each reinforcing strand with epoxy adhesive.
 - 3. Grounding: Continuous copper ground wire cast into pole. Terminate at top of pole.
 - 4. Raceway: Smooth, internal, and not less than 3 inches (76 mm) in diameter.
- B. Concrete: Minimum 28-day compressive strength of 7000 psi (48,265 kPa) .

- C. Cured with wet steam and aged for a minimum of 15 days prior to installation.
- D. Surface Treatment: Hard, nonporous, and resistant to water, frost, and road and soil chemicals; and shall have a maximum water-absorption rate of 3 percent.
- E. Fasteners: Galvanized steel, size and type as determined by manufacturer. Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
- F. Nameplate: Aluminum cast into pole wall at approximately 5 feet (1.5 m) above ground line, listing name of manufacturer, Project identifier, overall height, and approximate weight.
- G. Pole Brackets: Comply with ANSI C136.31.

2.5 POLE ACCESSORIES

- A. Duplex Receptacle: Ground-fault circuit interrupter type, 120 V ac, 20 A in a weatherproof assembly. Comply with requirements in Section 262726 "Wiring Devices."
- B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.
- C. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.
- D. Transformer-Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and to accept ballast(s) or indicated accessories. Include removable flanged access cover secured with bolts or screws.
- E. Decorative accessories, supplied by decorative pole manufacturer, include the following:
 - 1. Banner Arms, Flag Holders, Finials, Flower Pot Hooks.

2.6 LOWERING SYSTEM FOR LUMINAIRES

- A. System Description: Capable of lowering luminaire to a service position within 36 inches of finished grade in winds up to 30 mph. Provide manual plug connection to electrical power accessible in lowered position. Assembled system of pole, luminaire, and lowering device shall be capable of loads specified in "Performance Requirements" Article.
- B. Compatibility of Material: Materials for attachment and connection of luminaire-mounting assembly, lowering device, lowering cable, and portable winch shall be compatible to avoid corrosion and electrolysis.
- C. Structural and Mechanical Design Safety Factor: 5.0, minimum, for static and dynamic loads of load-bearing components, including cable.
- D. Luminaire-Mounting and Disconnect Arrangement: Multiple ring mounted luminaires, arranged for lowering and rising as a group.
 - 1. Electrical cable for normal operating power to luminaires shall manually disconnect inside pole base, using weatherproof multi-pin connector, and shall be arranged to move within the pole during lowering and rising of luminaire assembly.
 - 2. Electrical cable for normal operating power to luminaires shall automatically disconnect at weatherproof multi-pin connector within the pole-top lowering head at the beginning of the lowering cycle and reconnect when luminaire or luminaire assembly is raised to the operating position.

- E. Lowering Device: Weatherproof, cast-aluminum housing, and multiple mechanical latches. Moving parts of latching assembly shall be located in the portion of the unit that is lowered to servicing position. Positive latching in the operating position shall be indicated to the operator at the base of the pole by a clear visual signal or by other means acceptable to Owner or authorities having jurisdiction.
- F. Lowering Cable: Zinc-electroplated- steel aircraft cable.
- G. Portable Winch: Manual type. One <1> required.
 - 1. Winch Power Connection: Cord and plug.
 - 2. Winch Raise-Lower Control: Remote-control station with 15 feet of cable.

2.7 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to ASTM F 1554 with a minimum yield strength of 55,000 psi.
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
 - 2. Threading: Uniform National Coarse, Class 2A.
- B. Nuts: ASTM A 563, Grade A, Heavy-Hex
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
 - 2. Two <2> nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.
- C. Washers: ASTM F 436, Type 1.
 - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
 - 2. Two <2> washers provided per anchor bolt.

2.8 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 unacceptable. 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 poles, luminaire-mounting devices and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- B. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- C. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories.
 - 1. Baseplate: Stamped with manufacturer's name, date of production, and cable entry.
- D. Direct-Buried Foundations: Install to depth indicated on Drawings, but not less than one-sixth of pole height. Add backfill in 6-inch to 9-inch layers, tamping each layer before adding the next. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.
- E. Direct-Buried Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.
 - 1. Make holes 6 inches in diameter larger than pole diameter.
 - 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days and finish in a dome above finished grade.
 - 3. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
 - 4. Cure concrete a minimum of 72 hours before performing work on pole.
- F. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.3 POLE INSTALLATION

- A. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
 - 1. Fire Hydrants and Water Piping: 60 inches .
 - 2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet .
 - 3. Trees: 15 feet from tree trunk.
- B. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
 - 1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 2. Install base covers unless otherwise indicated.
 - 3. Use a short piece of 1/2 -inch (13-mm) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

- D. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Inspect poles for nicks, mars, dents, scratches, and other damage.
 - 2. System function tests.

END OF SECTION 26 56 13

SECTION 26 56 19
LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for LED luminaires indicated in the Luminaire Schedule on the drawings.
- B. Luminaire supports.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests IES LM-79 and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 - 7. LED driver or power supply product data sheets for each luminaire.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.
4. Where specifically indicated on plans, include photometric PxP drawings for areas where alternate fixtures are supplied.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing laboratory providing photometric data for luminaires.

B. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each type of luminaire.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. One (1) copy of each approved submittal.
2. Certificate of Material Receipt.

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. Drivers: TEN percent of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: ONE percent of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: ONE percent of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Provide luminaires from a single manufacturer for each luminaire type.

B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

C. Mockups: For exterior luminaires, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect 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.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: FIVE year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Refer to Luminaire Schedule on drawings for Luminaire types and construction requirements.
- B. 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.
- C. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- E. UL Compliance: Comply with UL 1598 and listed for wet location.
- F. LED lamps and driver shall have a rated life of minimum 50,000 hours.
- G. LED driver shall meet ANSI C62.41 Category. A surge protection standard up to 4 kV.
- H. CRI of minimum 80. CCT of 4000K unless otherwise noted.
- I. Ambient Temperature: LED Luminaire shall be rated from 5 deg F to +104 deg F.
- J. In-line Fusing: Separate in-line fuse for each luminaire.
- K. LED Lamp Module Rating: Lamp marked for outdoor use.
- L. Source Limitations: Obtain luminaires from single source from a single manufacturer.

- M. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. 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 ANSI C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRE TYPES

- A. Provide types as indicated in Luminaire Schedule and as indicated on drawings.

2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Metal Components: As indicated in Luminaire Schedule. Form and support to prevent warping and sagging.
- C. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

2.6 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. 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.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Finish Color: Unless otherwise noted, color shall be selected by the architect. Provide color chip samples or selection sheet with shop drawings.

2.7 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

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. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Fasten luminaire to structural support.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
 - 1. Where recommended by luminaire manufacturer, attach to structural members in walls. Otherwise mount fixture to back box.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Coordinate layout and installation of luminaires with other construction.
- H. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 BOLLARD LUMINAIRE INSTALLATION:

- A. Align units for optimum directional alignment of light distribution.
 - 1. Install on concrete base. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Refer to details on drawings for mounting orientation and requirements.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - b. IES LM-50.
 - c. IES LM-52.
 - d. IES LM-64.
 - e. IES LM-72.
 - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. 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.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train, Owner's maintenance personnel to adjust, operate, and maintain luminaires and any photocell relays.

3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within the warranty period, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to TWO visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace LED module, driver or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 56 19

SECTION 28 31 11

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Air-sampling smoke detectors.
5. Nonsystem smoke detectors.
6. Heat detectors.
7. Notification appliances.
8. Device guards.
9. Firefighters' two-way telephone communication service.
10. Firefighters' smoke-control station.
11. Magnetic door holders.
12. Remote annunciator.
13. Graphic annunciator.
14. Addressable interface device.
15. Digital alarm communicator transmitter.
16. Radio alarm transmitter.
17. Network communications.
18. System printer.

1.2 DEFINITIONS

- A. FACP: Fire Alarm Control Panel.
- B. NICET: National Institute for Certification in Engineering Technologies.
- C. PC: Personal computer.

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. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. 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.

4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. 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.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. 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.
13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device.

C. General Submittal Requirements:

1. 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
- D. 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. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
- g. Record copy of site-specific software.
- h. 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.
- i. Manufacturer's required maintenance related to system warranty requirements.
- j. 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. Heat 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. Keys and Tools: ONE extra set for access to locked or tamper-proofed components.
 4. Addressable interface device: TWO of each type installed.
 5. Fuses: TWO of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.
 6. Filters for Air-Sampling Detectors: Quantity equal to TWO percent of amount of each type installed, but no fewer than one unit of each type.
 7. Air-Sampling Fan: Quantity equal to ONE for every five detectors, but no fewer than one unit of each type.
- B. ADDITIONAL INSTALLED DEVICES**
1. Electrical Contractor shall include in his bid an allowance for the installation of the following:
 - a. Heat detectors Three
 - b. Manual fire alarm box One
 2. The contractor shall include 50'-0" length of conduit and wire for each device, and shall assume that the devices will be installed at the completion of the project as directed by the Architect or

Engineer. If not all devices are used, the remaining devices shall be turned over to the Owner. The unused amount of labor, conduit and wire shall be credited to the Owner in a deduct change order.

1.7 QUALITY ASSURANCE

- A. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.8 PROJECT CONDITIONS

- A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
- B. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.9 SEQUENCING AND SCHEDULING

- A. Prior to beginning work to modify an existing fire alarm system, the contractor shall verify at the control panel that the system has no faults, alarms, or trouble conditions. Verification shall occur in the presence of the Owner or Owner's Rep.
- B. 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.
- C. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: FIVE years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Automatic sensitivity control of certain smoke detectors.
- B. All components provided shall be listed for use with the selected system.
- 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.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire Alarm Signal:

1. Fire Alarm signal initiation shall be by one or more of the following devices and/or systems:
 - a. Heat detectors.
2. Fire-alarm signal shall initiate the following actions:
 - a. Continuously operate alarm notification appliances.
 - b. Identify alarm and specific initiating device at fire-alarm control units and remote annunciators.
 - c. Identify alarm and specific initiating device at connected network control panels and/or off-premises network control panels.
 - d. Transmit an alarm signal to the remote alarm receiving station.
 - e. Unlock electric door locks in designated egress paths.
 - f. Release fire and smoke doors held open by magnetic door holders.
 - g. Activate voice/alarm communication system.
 - h. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - i. Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
 - j. Activate stairwell and elevator-shaft pressurization systems.
 - k. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 - l. Activate preaction system.
 - m. Recall elevators to primary or alternate recall floors.
 - n. Activate elevator power shunt trip.
 - o. Activate emergency lighting control.
 - p. Activate emergency shutoffs for gas and fuel supplies.
 - q. Record events in the system memory.
 - r. Record events by the system printer.
 - s. Indicate device in alarm on the graphic annunciator.

B. Supervisory Signal:

1. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - a. Valve supervisory switch.
 - b. High- or low-air-pressure switch of a dry-pipe or pre-action sprinkler system.
 - c. Alert and Action signals of air-sampling detector system.
 - d. Elevator shunt-trip supervision.
 - e. Fire pump running.
 - f. Fire-pump loss of power.
 - g. Fire-pump power phase reversal.
 - h. Independent fire-detection and -suppression systems.
 - i. User disabling of zones or individual devices.
 - j. Loss of communication with any panel on the network.
 - k. Generator running
 - l. Generator abnormal condition (e.g. failure to start, temperature alarms, low fluids, etc.)
2. System Supervisory signal shall initiate the following actions:
 - a. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
 - b. Record the event on system printer.
 - c. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
 - d. Transmit system status to building management system.
 - e. Display system status on graphic annunciator.

C. System Trouble Signal:

1. System trouble signal initiation shall be by one or more of the following devices and actions:
 - a. Open circuits, shorts, and grounds in designated circuits.

- b. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - c. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 - d. Loss of primary power at fire-alarm control unit.
 - e. Ground or a single break in internal circuits of fire-alarm control unit.
 - f. Abnormal ac voltage at fire-alarm control unit.
 - g. Break in standby battery circuitry.
 - h. Failure of battery charging.
 - i. Abnormal position of any switch at fire-alarm control unit or annunciator.
 - j. Voice signal amplifier failure.
 - k. Hose cabinet door open.
2. System trouble signal shall initiate the following actions:
- a. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
 - b. Record the event on system printer.
 - c. Transmit system status to building management system.
 - d. Display system status on graphic annunciator.

2.3 PERFORMANCE REQUIREMENTS

2.4 FIRE-ALARM CONTROL UNIT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers:
- 1. Fire-Lite Alarms.
 - 2. GAMEWELL.
 - 3. GE UTC Fire & Security; A United Technologies Company.
 - 4. Honeywell.
 - 5. Notifier.
 - 6. Siemens Industry, Inc.; Fire Safety Division.
 - 7. Silent Knight.
 - 8. SimplexGrinnell LP.
 - 9. EST Edwards
- B. 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 500-event history log.

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.
- C. 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, two line(s) of 40 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Contractor shall verify quantity of each circuit type required with his approved equipment vendor prior to bidding. Fire alarm riser drawings that may be shown on the drawings are intended to be schematic in nature and may not depict all circuits where multiple circuits are required.
 2. Pathway Class Designations: NFPA 72, Class A.
 3. Pathway Survivability: Level 1.
 4. Install no more than 50, 100 addressable devices on each signaling-line circuit.
 5. Serial Interfaces:
 - a. One dedicated RS 485 port for central-station remote station operation using point ID DACT.
 - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - c. One USB RS 232 port for PC configuration.
 - d. One RS 232 port for voice evacuation interface.
- E. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
 3. Record events by the system printer.
 4. Sound general alarm if the alarm is verified.
 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- F. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
 2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
 3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- G. Elevator Recall:
1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
 3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.

- a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- H. 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.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
 - 1. Indicate 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.
 - a. Allow the application of, and evacuation signal to, indicated number of zones and, at the 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.
- J. 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.
- K. 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 signals 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.
- L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed, valve-regulated, recombinant lead acid, Sealed lead calcium.
- M. Surge Suppression: Provide surge suppression devices at each 120V circuit serving fire alarm equipment. Refer to specification section 26 43 13 – Surge Protection for Low Voltage Electrical Power for requirements.
- N. 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.

2.5 PREACTION SYSTEM

- A. Initiate Presignal Alarm: This function shall cause an audible and visual alarm and indication to be provided at the FACP. Activation of an initiation device connected as part of a preaction system shall be annunciated at the FACP only, without activation of the general evacuation alarm.

2.6 REMOTE FIRE ALARM DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers:

1. Cooper Wheelock.
2. Fire-Lite Alarms.
3. GAMEWELL.
4. GE UTC Fire & Security; A United Technologies Company.
5. Notifier.
6. Siemens Industry, Inc.; Fire Safety Division.
7. Silent Knight.
8. SimplexGrinnell LP.
9. System Sensor.

10. Voice/Tone Notification Appliances:
 - a. Comply with UL 1480.
 - b. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
 - c. High-Range Units: Rated 2 to 15 W.
 - d. Low-Range Units: Rated 1 to 2 W.
 - e. Mounting: Flush semirecessed or surface mounted and bidirectional.
 - f. Matching Transformers: Tap range matched to acoustical environment of speaker location.
 - g. Mounting Faceplate: Factory finished, **RED WHITE**.

11. Exit Marking Audible Notification Appliance:
 - a. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
 - b. Provide exit marking audible notification appliances at the entrance to all building exits.
 - c. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.

- B. Addressable Interface Device

1. General:
 - a. Include address-setting means on the module.
 - b. Store an internal identifying code for control panel use to identify the module type.
 - c. Listed for controlling HVAC fan motor controllers.

2. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
3. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown .
 - a. Allow the control panel to switch the relay contacts on command.
 - b. Have a minimum of two normally open and two normally closed contacts available for field wiring.

4. Control Module:
 - a. Operate notification devices.
 - b. Operate solenoids for use in sprinkler service.

C. System Smoke Detectors

1. General Requirements for System Smoke Detectors:
 - a. Comply with UL 268; operating at 24-V dc, nominal.
 - b. Detectors shall be two-wire type.
 - c. 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.
 - d. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - e. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
 - 1) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
 - 2) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units 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.
 - 3) Multiple levels of detection sensitivity for each sensor.
 - 4) Sensitivity levels based on time of day.
2. Photoelectric Smoke Detectors:
 - a. 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.
 - b. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).
3. Ionization Smoke Detector:
 - a. 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.
 - b. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).
4. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
 - a. 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.
 - b. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).
 - c. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
 - d. Each sensor shall have multiple levels of detection sensitivity.
 - e. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 - f. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.
5. Projected Beam Smoke Detectors

- a. Projected Beam Light Source and Receiver: Designed to accommodate small angular movements and continue to operate and not cause nuisance alarms.
- b. Detector Address: Accessible from fire-alarm control unit and able to identify the detector's location within the system and its sensitivity setting.
- c. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).

D. Carbon Monoxide Detectors

1. General: Carbon monoxide detector listed for connection to fire-alarm system.
 - a. Mounting: Adapter plate for outlet box mounting.
 - b. Testable by introducing test carbon monoxide into the sensing cell.
 - c. Detector shall provide alarm contacts and trouble contacts.
 - d. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
 - e. Comply with UL 2075.
 - f. Locate, mount, and wire according to manufacturer's written instructions.
 - g. Provide means for addressable connection to fire-alarm system.
 - h. Test button simulates an alarm condition.

E. Multicriteria Detectors

1. Mounting: Adapter plate for outlet box 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.
3. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.
4. Test button tests all sensors in the detector.
5. 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 sensitivity selected.
 - d. Sensor range (normal, dirty, etc.).
6. Sensors: The detector shall be comprised of four sensing elements including a smoke sensor, a carbon monoxide sensor, an infrared sensor, and a heat sensor.
 - a. Smoke sensor shall be photoelectric type as described in "System Smoke Detectors" Article.
 - b. Carbon monoxide sensor shall be as described in "Carbon Monoxide Detectors" Article.
 - c. Heat sensor shall be as described in "Heat Detectors" Article.
 - d. Each sensor shall be separately listed according to requirements for its detector type.

F. Nonsystem Smoke Detectors

1. General Requirements for Nonsystem Smoke Detectors:
 - a. Nonsystem smoke detectors shall be listed as compatible with the fire-alarm equipment installed or shall have a contact closure interface listed for the connected load.
 - b. Nonsystem smoke detectors shall meet the monitoring for integrity requirements in NFPA 72.

2. Single-Station Smoke Detectors:
 - a. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device.
 - b. Auxiliary Relays: One Form C, rated at 0.5 A Form A and one Form C, both rated at 0.5 A.
 - c. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet according to UL 464.
 - d. Visible Notification Appliance: 177-cd strobe.
 - e. Heat sensor, 135 deg F combination rate-of-rise and fixed temperature.
 - f. Test Switch: Push to test; simulates smoke at rated obscuration.
 - g. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
 - h. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - i. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
 - j. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
3. Single-Station Duct Smoke Detectors:
 - a. Comply with UL 268A; operating at 120-V ac.
 - b. Sensor: LED or infrared light source with matching silicon-cell receiver.
 - 1) Detector Sensitivity: Smoke obscuration between 2.5 and 3.5 percent/foot when tested according to UL 268A.
 - c. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.
 - 1) Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; listed for use with the supplied detector.
 - d. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 - e. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

G. Heat Detectors

1. General Requirements for Heat Detectors: Comply with UL 521.
 - a. Temperature sensors shall test for and communicate the sensitivity range of the device.
2. 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.
 - a. Mounting: Adapter plate for outlet box mounting Twist-lock base interchangeable with smoke-detector bases.
 - b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
 - a. Mounting: Adapter plate for outlet box mounting Twist-lock base interchangeable with smoke-detector bases.
 - b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Continuous Linear Heat-Detector System:
 - a. Detector Cable: Rated detection temperature 155 deg F. Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.

- b. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
- c. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
- d. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

H. Air-Sampling Smoke Detector

- 1. General Description:
 - a. Air-sampling smoke detector shall be laser based using a piping system and a fan to transport the particles of combustion to the detector.
 - b. Provide two levels of alarm from each zone covered by the detector and two supervisory levels of alarm from each detector.
 - c. The air being sampled shall pass through filters to remove dust particulates greater than 20 microns before entering the detection chamber.
 - d. Detectors shall have the capability via RS 485 to connect up to 100 detectors in a network.
 - e. Detectors shall communicate with the fire-alarm control unit via addressable, monitored dry contact closures, RS 485, and interface modules. Provide a minimum of six relays, individually programmable remotely for any function.
 - f. Pipe airflow balancing calculations shall be performed using approved calculation software.
- 2. Detector:
 - a. Detector, Filter, Aspirator, and Relays: Housed in a mounting box and arranged in such a way that air is drawn from the detection area and a sample passed through the dual-stage filter and detector by the aspirator.
 - b. Obscuration Sensitivity Range: 0.005 - 6 percent obs/ft.
 - c. Four independent, field-programmable, smoke-alarm thresholds per sensor pipe and a programmable scan time delay. The threshold set points shall be programmable.
 - 1) The four alarm thresholds may be used as follows:
 - a) Alarm Level 1 (Alert): Activate a visual and an audible supervisory alarm.
 - b) Alarm Level 2 (Action): Activate shutdown of electrical/HVAC equipment and activate a visual and an audible supervisory alarm.
 - c) Alarm Level 3 (Fire 1): Activate building alarm systems and initiate call to fire response unit.
 - d) Alarm Level 4 (Fire 2): Activate suppression system or other countermeasures.
 - 2) Final Detection System Settings: Approved by Architect Owner.
 - 3) Initial Detection Alarm Settings:
 - a) Alarm Level 1 (Alert): 0.08 percent obs/ft.
 - b) Alarm Level 2 (Action): 1.0 percent obs/ft.
 - c) Alarm Level 3 (Fire 1): 2.0 percent obs/ft.
 - d) Alarm Level 4 (Fire 2): 4.0 percent obs/ft.
 - d. Power Supply:
 - 1) Regulated 24-V dc, monitored by the fire-alarm control unit, with battery backup.
 - 2) Battery backup shall provide 24 hours' standby, followed by 30 minutes at maximum connected load.
 - e. Detector shall also transmit the following faults:
 - 1) Detector.
 - 2) Airflow.
 - 3) Filter.
 - 4) System.
 - 5) Zone.
 - 6) Network.
 - 7) Power.
 - f. Provide four in-line sample pipe inlets that shall contain a flow sensor for each pipe inlet. The detector shall be capable of identifying the pipe from which smoke was detected.

- g. Aspirator: Air pump capable of allowing for multiple sampling pipe runs up to 650 feet in total, (four pipe runs per detector) with a transport time of less than 120 seconds from the farthest sample port.
 - h. Air-Sampling Flow Rates Outside Manufacturer's Specified Range: Result in a trouble alarm.
 - i. Provide software-programmable relays rated at 2 A at 30-V dc for alarm and fault conditions.
 - j. Provide built-in event and smoke logging; store smoke levels, alarm conditions, operator actions, and faults with date and time of each event. Each detector (zone) shall be capable of storing up to 18,000 events.
 - k. Urgent and Minor Faults. Minor faults shall be designated as trouble alarms. Urgent faults, which indicate the unit may not be able to detect smoke, shall be designated as supervisory alarms.
- 3. Displays:
 - a. Include display module within each detector.
 - b. Each display shall provide the following features at a minimum:
 - 1) A bar-graph display.
 - 2) Four independent, high-intensity alarm indicators (Alert, Action, Fire 1, and Fire 2), corresponding to the four alarm thresholds of the indicated sector.
 - 3) Alarm threshold indicators for Alert, Action, and Fire 1.
 - 4) LED indication that the first alarm sector is established.
 - 5) Detector fault and airflow fault indicators.
 - 6) LED indicators shall be provided for faults originating in the particular zone (Zone Fault), faults produced by the overall smoke-detection system, and faults resulting from network wiring errors (Network Fault).
 - 7) Minor and urgent LED fault indicators.
- 4. Sampling Tubes:
 - a. Smooth bore with a nominal 1-inch OD and a 7/8-inch ID. Sampling pipe with between 5/8- and 1-inch ID can be used in specifically approved locations when recommended by manufacturer.
 - b. Pipe Material: CPVC and complying with UL 1887, "Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics."
 - c. Joints in the sampling pipe shall be airtight. Use solvent cement approved by the pipe manufacturer on all joints except at entry to the detector.
 - d. Identify piping with labels reading: "Aspirating Smoke Detector Pipe - Do Not Paint or Disturb" along its entire length at regular intervals according to NFPA 72.
 - e. Support pipes at not more than 60-inch centers.
 - f. Fit end of each trunk or branch pipe with an end cap and drilled with a hole appropriately sized to achieve the performance as specified and as calculated by the system design.
- 5. Sampling Holes:
 - a. Sampling holes of 5/64 inch, or other sized holes per manufacturer's written instructions, shall be separated by not more than the maximum distance allowable for conventional smoke detectors. Intervals may vary according to calculations.
 - b. Follow manufacturer's written recommendations to determine the number and spacing of sampling points and the distance from sampling points to ceiling or roof structure and to forced ventilation systems.
 - c. Each sampling point shall be identified by an applied decal.
- I. Magnetic Door Holders
 - 1. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
 - a. Electromagnets: Require no more than 3 W to develop 25-lbf holding force.
 - b. Wall-Mounted Units: Flush mounted unless otherwise indicated.
 - c. Rating: 24-V ac or dc. Rating: 120-V ac.

2. Material and Finish: Match door hardware.

J. Graphic Annunciator

1. Graphic Annunciator Panel: Mounted in an aluminum frame with nonglare, minimum 3/16-inch-thick, clear acrylic cover over graphic representation of the facility. Detector locations shall be represented by red LED lamps. Normal system operation shall be indicated by a lighted, green LED. Trouble and supervisory alarms shall be represented by an amber LED.
 - a. Comply with UL 864.
 - b. Operating voltage shall be 24-V dc provided by a local 24-V power supply provided with the annunciator.
 - c. Include built-in voltage regulation, reverse polarity protection, RS 232/422 serial communications, and a lamp test switch.
 - d. Surface mounted in a NEMA 250, Type 1 cabinet, with key lock and no exposed screws or hinges.
 - e. Graphic representation of the facility shall be a CAD drawing and each detector shall be represented by an LED in its actual location. CAD drawing shall be at 1/8-inch per foot scale or larger.
 - f. The LED representing a detector shall flash two times per second while detector is an alarm.
2. Graphic Annunciator Workstation: PC-based, with fire-alarm annunciator software with historical logging, report generation, and a graphic interface showing all alarm points in the system. PC with operating system software, minimum 500GB hard drive, 19" digital display monitor, with wireless keyboard and mouse.

K. Remote Annunciator

1. 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.
 - a. Mounting: Flush Surface cabinet, NEMA 250, Type 1.
2. 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.

2.7 FIREFIGHTERS' TWO-WAY TELEPHONE COMMUNICATION SERVICE

- A.** Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control unit, and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:

1. Common-talk type for firefighter use only Selective-talk type for use by firefighters and fire wardens.
2. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously. An indicator lamp shall flash if a phone is disconnected from the talk circuits.
3. Addressable firefighters' phone modules to monitor and control a loop of firefighter phones. Module shall be capable of differentiating between normal, off-hook, and trouble conditions.
4. Selector panel controls to provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.
5. Display: Graphic digital to indicate location of caller.
6. Remote Telephone Cabinet: Flush- or surface-mounted cabinet as indicated, factory-standard red finish, with handset.
 - a. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Warden Phone" or "Fire Emergency Phone."
 - b. With "break-glass" type door access lock.

7. Remote Telephone Jack Stations: Single-gang, stainless-steel-plate mounted plug, engraved "Fire Warden Phone" or "Fire Emergency Phone."
8. Handsets: push-to-talk-type sets with noise-canceling microphone stored in a cabinet adjacent to fire-alarm control unit in the fire command center.

2.8 FIREFIGHTERS' SMOKE-CONTROL SYSTEM

A. Initiate Smoke-Management Sequence of Operation:

1. Comply with sequence of operation as described in Section 230993 "Sequence of Operations for HVAC Controls."
2. Fire-alarm system shall provide all interfaces and control points required to properly activate smoke-management systems.
3. First fire-alarm system initiating device to go into alarm condition shall activate the smoke-control functions.
4. Subsequent devices going into alarm condition shall have no effect on the smoke-control mode.

B. Addressable Relay Modules:

1. Provide address-setting means on the module. Store an internal identifying code for control panel use to identify the module type.
2. Allow the control panel to switch the relay contacts on command.
3. Have a minimum of two normally open and two normally closed contacts available for field wiring.
4. Listed for controlling HVAC fan motor controllers.

2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.10 RADIO ALARM TRANSMITTER

- A. Transmitter shall comply with NFPA 1221 and 47 CFR 90.
- B. Description: Manufacturer's standard commercial product; factory assembled, wired, and tested; ready for installation and operation.
 - 1. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
 - 2. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
 - 3. Normal Power Input: 120-V ac.
 - 4. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
 - 5. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand **100 mph** with a gust factor of 1.3 without failure.
 - 6. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
 - 7. Antenna-Cable Connectors: Weatherproof.
 - 8. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.
- C. Functional Performance: Unit shall receive alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions:
 - 1. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
 - 2. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
 - 3. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
 - 4. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
 - 5. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
 - 6. Local Fire-Alarm-System, Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm .

2.11 NETWORK COMMUNICATIONS

- A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.
- B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.
- C. Provide integration gateway using BACnet Modbus for connection to building automation system.

2.12 SYSTEM PRINTER

- A. Printer shall be listed and labeled as an integral part of fire-alarm system.

2.13 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by device manufacturer.
 - 2. Finish: Paint of color to match the protected device.

2.14 FIRE ALARM CABLE

- A. Furnish only wire recommended by the fire alarm system manufacturer. Coordinate closely with equipment vendor for quantity, type, and size of fire alarm cables required.
- B. Network Riser Cable: Utilize MI type cable, 2-hour fire resistive rating. Applies to all wiring between fire alarm control panels (FACP) and between control panels and notification appliance cabinets (NAC).
- C. SLC Circuit Cable for Addressable Initiation Devices: Power-limited (FPLP) solid or stranded (7 strand minimum) copper, 75 Degrees C insulation, #18 AWG twisted, shielded or unshielded, color-coded vinyl insulation, PVC jacket.
- D. NAC Circuit Cable for Notification Devices: Power-limited (FPLP), solid or stranded (7 strand minimum) copper, 75 Degrees C insulation, #14 AWG twisted, shielded or unshielded, color-coded vinyl insulation, PVC jacket.
- E. 600V THHN shall be suitable for use with SLC and NAC circuits, #18 AWG and #14 AWG, respectively.
- F. All wiring shall be color coded and labeled at each end. Splicing by way of wire nuts is prohibited.
- G. All fire alarm wiring shall be plenum rated where located in air plenum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. 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 monitoring equipment as necessary to extend existing control monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- C. Equipment Mounting: Install fire-alarm control unit on finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
 - 2. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- F. Smoke- or Heat-Detector Spacing:
 - 1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 - 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
- G. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- H. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
 - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- I. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.
- J. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

- K. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- L. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- M. 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. Install all devices at the same height unless otherwise indicated.
- N. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
- O. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- P. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that resists 100-mph wind load with a gust factor of 1.3 without damage.

3.3 PATHWAYS

- A. Fire alarm cable above ceilings and in non-accessible locations may be routed exposed, where supported by j-hooks or other approved method.
 - 1. Exposed fire alarm cable located less than 96 inches above the floor shall be installed in raceway.
- B. Fire alarm cable shall be installed in raceway.
- C. Where approved for use, THHN shall be installed in raceway.
- D. Exposed fire alarm raceways shall be painted red enamel.

3.4 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
 - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 - 3. Smoke dampers in air ducts of designated HVAC duct systems.
 - 4. Magnetically held-open doors.
 - 5. Electronically locked doors and access gates.
 - 6. Alarm-initiating connection to elevator recall system and components.
 - 7. Alarm-initiating connection to activate emergency lighting control.
 - 8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 9. Supervisory connections at valve supervisory switches.

10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
11. Supervisory connections at elevator shunt-trip breaker.
12. Data communication circuits for connection to building management system.
13. Data communication circuits for connection to mass notification system.
14. Supervisory connections at fire-extinguisher locations.
15. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
16. Supervisory connections at fire-pump engine control panel.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Perform the following 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 the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - b. Comply with the "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 the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the

"Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- I. 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.

3.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **TWELVE** months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for TWO years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within TWO years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

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

SECTION 31 10 00

SITE CLEARING

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. Protecting existing vegetation to remain.
 - 2. Removing existing vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.
 - 6. Disconnecting, capping or sealing, removing site utilities, and abandoning site utilities in place.
- B. Related Requirements:
 - 1. Section 01 50 00 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

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- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Topsoil stripping and stockpiling program.
- C. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD 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 trafficways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises at location specified by Owner.
- C. Utility Locator Service: Notify Call Before You Dig for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- E. Tree- and Plant-Protection Zones: Protect according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."
- F. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 20 00 "Earth Moving."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- 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 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site as indicated on the drawings.
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations.

3.3 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.
- B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- C. Interrupting 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 Architect 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.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, 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. Grind down stumps and remove roots larger than 3 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods or air spade for grubbing within protection zones.
 - 4. Chip removed 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.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within protection zones.
 - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

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1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. 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.

END OF SECTION

SECTION 31 20 00

EARTH MOVING

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. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Drainage course for slabs-on-grade.
 - 4. Subbase course for concrete walks and pavements.
- B. Related Sections include the following:
 - 1. Section 31 10 00 "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.
 - 2. Section 32 92 00 "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for lawns.
 - 3. Section 32 93 00 "Plants" for planting bed establishment and tree and shrub pit excavation and planting.

1.3 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. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

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- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
- G. Fill: Soil materials used to raise existing grades.
- 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: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a 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.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Geotextile.
 - 2. Controlled low-strength material, including design mixture.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
- B. Geotechnical Testing Agency Qualifications: Owner will employ and pay a qualified, independent geotechnical testing laboratory to perform soil testing and inspection services during earthwork operations. Contractor shall be responsible for scheduling and coordination of these services.
- C. Pre-excavation Conference: Before commencing earthwork, meet with representatives of governing authorities, Owner, Architect, Structural Engineer, consultants, Geotechnical Testing Agency and other concerned entities. Review earthwork

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procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least three working days prior to convening conference. Record discussions and agreements and furnish a copy to each attendee.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Construction Manager 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 Construction Manager's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. 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.

PART 2 - PRODUCTS**2.1 SOIL MATERIALS**

- A. General: Provide off-site borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations.
- B. Satisfactory Soils: On site soils satisfactory to testing agency, containing less than 25% pulverized shale fragments, free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, organics, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Silt, highly organic soils, wood, roots, trash, debris, and other soils and materials not acceptable to the testing agency.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

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- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or 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. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or 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.
- G. 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.
- H. Drainage Course: Narrowly graded mixture of washed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 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; as noted on drawings.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; as noted on the drawings.

PART 3 - EXECUTION**3.1 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. Protect and maintain erosion and sedimentation controls during earthwork operations.
- C. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 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 utility trenches as temporary drainage ditches.
 - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 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.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

- A. For sanitary sewer, storm sewer, and water lines, please see the corresponding spec sections. For other site utilities follow below.
- B. 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.
- C. 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.
- D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 SUBGRADE INSPECTION

- A. Notify testing agency when excavations have reached required subgrade.
- B. If testing agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Construction Manager, without additional compensation.

3.8 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 may be used when approved by Geotechnical Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Construction Manager.

3.9 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.

3.10 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.

3.11 UTILITY TRENCH BACKFILL

- A. For sanitary sewer, storm sewer, and water lines, please see the corresponding spec sections. For other site utility backfill, follow below.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.
- C. 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.

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- D. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.
- E. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- F. Place and compact initial backfill material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit in non-paved areas.
 - 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.
- G. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit in paved areas.
- H. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- I. Place and compact final backfill of satisfactory soil to final subgrade elevation in non-paved areas.
- J. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation in paved areas.

3.12 SOIL FILL

- A. Plow, 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 in accordance with sections 3.13 and 3.14 and as follows:
 - 1. Under grass and planted areas, use satisfactory soil material or engineered fill.
 - 2. Under walks and pavements, use satisfactory soil material (excluding topsoil) or engineered fill.
 - 3. Under steps and ramps, use satisfactory soil material (excluding topsoil) or engineered fill.
 - 4. Under building slabs, use satisfactory soil material (excluding topsoil) or engineered fill.
 - 5. Under footings and foundations, use satisfactory (excluding topsoil) soil material or engineered fill.

- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 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.
 - 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.

3.14 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 following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, including 10 feet beyond all such areas, compact each layer of backfill or fill soil material at 100 percent maximum dry density.
 - 2. Under walkways, compact each layer of backfill or fill soil material at 100 percent maximum dry density.
 - 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 95 percent maximum dry density.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 100 percent maximum dry density.

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3.15 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 subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 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.

3.16 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.

3.17 SUBBASE AND BASE COURSES

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 1. Where specified install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Shape subbase and base course to required crown elevations and cross-slope grades.
 3. Place subbase and base 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.
 4. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry density.
- 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 density.

3.18 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 3. Place drainage 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.

4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. 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.
- C. 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.

3.20 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 Construction Manager; 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.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Transport surplus soil material offsite to a legal disposal site off Owner's property.

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1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.
- B. Excavated pavements shall be considered waste material and shall not be incorporated into fills.

END OF SECTION

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ASPHALT PAVING

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. Cold milling of existing asphalt pavement.
 - 2. Hot-mix asphalt patching.
 - 3. Hot-mix asphalt paving.
 - 4. Hot-mix asphalt overlay.
 - 5. Pavement-marking paint.
- B. Related Requirements:
 - 1. Section 31 20 00 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.
 - 2. Job-Mix Designs: For each job mix proposed for the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each paving material. Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.
- B. Material Test Reports: For each paving material, by a qualified testing agency.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located
- B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Ohio Department of Transportation for asphalt paving work.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.7 FIELD 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: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
 - 2. Asphalt Base Course: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
 - 3. Asphalt Surface Course: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
- 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 degrees F for water-based materials, and not exceeding 95 degrees F.

PART 2 - PRODUCTS**2.1 AGGREGATES**

- A. General: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.
- B. Asphalt Cement: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.
- C. Tack Coat: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.
- D. Water: Potable.

2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled asphalt shingles from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Joint Sealant: ASTM D 6690, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.
- D. Pavement-Marking Paint: ODOT Item 642.
 - 1. Color: White, Yellow, & Blue.
- E. Wheel Stops: Precast, air-entrained concrete, 3500-psi minimum compressive strength, see drawings for dimensions. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: 2 - Galvanized steel, minimum 3/4-inch diameter.

2.4 MIXES

- A. Hot-Mix Asphalt: Use plant-mixed, hot-laid asphalt aggregate mixtures complying with the Ohio Department of Transportation Construction and Materials Specifications as indicated on the plans.

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. Proof rolling to be performed in presence of Architect or Construction Manager.
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, Construction Manager, or Geotechnical Engineer, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
 1. Mill to a depth as shown on plans.
 2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
 3. Control rate of milling to prevent tearing of existing asphalt course.
 4. Repair or replace curbs, driveway aprons, manholes, and other construction damaged during cold milling.
 5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
 6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.

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7. Keep milled pavement surface free of loose material and dust.
8. Do not allow milled materials to accumulate on-site.

3.3 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
 1. Undersealing: Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
 2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply 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.
- D. Placing Patch Material: 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.

3.4 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.

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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.

3.5 SURFACE PREPARATION

- A. 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 PLACING HOT-MIX ASPHALT

- A. Asphalt shall be placed in accordance with the Ohio Department of Transportation Construction and Material Specifications and as indicated on the plans.
- B. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in 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.

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2. Place hot-mix asphalt surface course in single lift.
 1. Spread mix at a minimum temperature as per the Ohio Department of Transportation Construction and Material Specifications.
 2. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 3. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- C. 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. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
 2. Complete a section of asphalt base course before placing asphalt surface course.
- D. 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.

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 per ODOT standards.
 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 within temperature specifications as set in the Ohio Department of Transportation Construction and Materials Specifications.
- 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, but not less than 94 percent or 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.

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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 straightedge applied transversely or longitudinally to paved areas:
1. Base Course: 1/4 inch.
 2. Surface Course: 1/8 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 per manufacturers recommendations 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 per ODOT 642 Specifications to a minimum wet film thickness of 20 mils.

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/D 3549M.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site,

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prepared according to ASTM D 2041/D 2041M, 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 1000 sq. yd. or less of installed pavement, with no fewer than three 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/D 2726M.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION

**SECTION 32 13 16
DECORATIVE CONCRETE PAVING**

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 buff wash finished concrete paving.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to decorative concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and decorative concrete paving construction practices.
 - 2. Require representatives of each entity directly concerned with decorative concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Decorative concrete paving Installer.
 - e. Manufacturer's representative of decorative concrete paving system.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color, pattern, or texture selection.
- C. Design Mixtures: For each decorative concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
- C. Material Test Reports: For each of the following:
 - 1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- D. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative concrete paving systems.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

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1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockups of full-thickness sections of decorative concrete paving to demonstrate typical joints; surface color, pattern, and texture; curing; and standard of workmanship.
 2. Build mockups of decorative concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches by 96 inches.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on decorative concrete paving mixtures.

1.9 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

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1. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F and not more than 80 degrees 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 design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 degrees F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in 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.

PART 2 - PRODUCTS**2.1 CONCRETE, GENERAL**

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
1. Use flexible or uniformly curved forms for curves of a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

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2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- B. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.
- C. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
- D. 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 specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.4 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, gray portland cement Type I.
 - 2. Fly Ash: ASTM C 618, Class C or F.
 - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving 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.
- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

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1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
3. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.

F. Water: Potable and complying with ASTM C 94/C 94M.

2.5 CURING AND SEALING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- B. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type I, Class B, manufactured for colored concrete.
 1. For integrally colored concrete, curing compound shall be pigmented type approved by coloring admixture manufacturer.
 2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.
- C. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type I, Class A, manufactured for use with colored concrete.
- D. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type I, Class A, manufactured for use with colored concrete.
- E. Clear Acrylic Sealer: Manufacturer's standard, waterborne, nonyellowing and UV-resistant, membrane-forming, medium-gloss, acrylic copolymer emulsion solution, manufactured for colored concrete, containing not less than 15 percent solids by volume.

2.6 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber, with joint sealant.
- B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy-Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES

- A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties.
- B. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
- C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Pozzolan: 25 percent.
 - 2. Slag Cement: 50 percent.
 - 3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- D. 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.
- E. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- F. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing 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.

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- G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- H. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum W/C Ratio at Point of Placement: 0.45.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: 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 degrees F and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees 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. Do not proof-roll wet or saturated subgrades
 - 1. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, Construction Manager, or Geotechnical Engineer, and replace with compacted backfill or fill as directed.
- 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.
- B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides 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 INSTALLATION

- 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.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges 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 paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

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1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 2. Butt Joints: Use bonding agent or epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt 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 where pavement abuts vertical structures and as shown on Drawings.
 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. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 5. 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.
 6. Apply joint sealant / caulk.
 7. Doweled Joints: Install dowel bars and support assemblies at joints where indicated, or when construction joint will experience heavy truck traffic. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.
 - a. Do not dowel into existing walls.
- 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. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Where joint ends adjacent to a structure, ensure that joint line continues to the face of the structure.
 - b. Provide plunge cut at perpendicular intersections at locations shown on the Drawings.
 2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-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 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. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- E. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- F. A one time add of water to concrete during delivery or at Project site is permitted but the water to cementitious material ratio must not be violated.
- G. Do not add water to fresh concrete after testing.
- H. 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.

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- I. 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.
- J. Screed paving surface with a straightedge and strike off.
- K. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

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 bleedwater 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 BUFF WASH FINISH

- A. After final floating, apply a hand-trowel finish followed by a buff washed finish to concrete. Allow concrete to cure to sufficient strength that it will not be damaged by blasting but not less than seven days. Use a High-Pressure Water-Jet to remove cement mortar from surface and expose aggregate to match approved mock-up
- B. Provide a buff washed finish on all exposed portions of concrete surfaces.

1. Perform a High-Pressure Water-Jet finish in as continuous operation as possible, utilizing the same work crew to provide finish matching the approved mock-up.
2. Use same nozzle person, nozzle, nozzle pressure, and blasting technique as used for the approved mock-up.
3. Blast corners and edges carefully, using backup boards in order to maintain a uniform corner or edge line.
4. Protect adjacent surfaces from being eroded, damaged, or discolored by finishing operations.

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 Compound: Apply immediately after final finishing. 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.
 1. Cure integrally colored concrete with a curing compound.
- F. Curing and Sealing 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.10 SEALER APPLICATION

- A. Clear Acrylic Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions. Allow first coat to dry before applying second

coat, at 90 degrees to the direction of the first coat, using same application methods and rates.

1. Begin sealing dry surface no sooner than 14 days after concrete placement.

3.11 TOLERANCES

- A. Comply with tolerances in 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, unlevelled 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. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.12 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 5000 sq. ft. 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.

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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 degrees F and below and when 80 degrees 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.

- I. Prepare test and inspection reports.

3.13 REPAIR AND PROTECTION

- A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- 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 decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 32 53

STONE WALLS

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. Stone seat wall set on concrete foundation.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-In-Place Concrete" for foundation under stone wall.

1.3 REFERENCES

- A. Federal, State and local laws and regulations governing this Work are hereby incorporated into and made part of this Section. When this Section calls for certain materials, workmanship, or a level of construction that exceeds the level of Federal, State, or local requirements, provisions of this Section take precedence.
- B. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
 - 1. American Society for Testing and Materials (ASTM):
 - a. C136 Sieve Analysis of Fine and Coarse Aggregates
 - b. C144 Aggregate for Masonry Mortar
 - c. C150 Portland Cement

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For materials other than water and aggregates.
- B. Samples for Verification: Include Samples of the following:
 - 1. Limestone walls.
 - 2. Sealant: Color charts.

1.6 QUALITY ASSURANCE

- A. Mockups: Before installing stone walls, build mockups to verify selection made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Size of mockup shall be a minimum 10 feet in length. Build mockups to comply with the following requirements, using materials indicated for the completed Work, including base construction and contiguous work as indicate:
 - 1. Build mockups in the location and of the size indicated or if not indicated as directed by Owner's Representative.
 - 2. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 3. Obtain Owner's Representative's approval of mockups before starting stone wall installation.
 - 4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 5. Mockup can become final part of work if approved by Owner's Representative.
- B. Sample mockup shall be inspected by the Owner's Representative. If the sample is not acceptable, construct additional mockups at no cost to the Owner until an acceptable mockup is constructed. Accepted mockup shall become the standard for the entire job, and shall remain undisturbed until completion of all work.
- C. Source Limitations: Obtain each type of stone, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.
- D. Certificates: Provide certificates as required by law for transportation and inspections of materials. Inspection and/or approval by governmental agencies does not preclude rejection of materials at project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stone shall be carefully packaged by the supplier for shipment.
- B. Stone shall be stored off the ground and protected against staining and other damage.
- C. Stone damaged in any manner will be rejected and replaced with new materials at no additional cost to the Owner.
- D. Store mortar, grout and cement material in tightly closed containers and protect from freezing.

1.8 FIELD CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Mortar and Grout:
 - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 degrees F and higher.

1.9 PROTECTION OF FINISHED SURFACES

- A. Finished surfaces of stone shall be adequately protected from soiling, staining and other damage during construction.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Source Limitations: Obtain each type of unit, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 STONE

- A. Material Standard: Comply with ASTM C 568.

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1. Classification: II Medium Density.
- B. Description: Oolitic limestone.
- C. Varieties and Sources: Indiana limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.
 1. Indiana Limestone Grade and Color: Select, buff, according to grade and color classification established by ILI.
- D. Dimensions and Finishes:
 1. Top Width: 18 inches.
 2. Face Height: Varies, top of wall shall be level.
 3. Length: As indicated on Drawings.
 4. Finish:
 - a. Top, bottom, and abutting ends: Sawn.
 - b. Front, back and non-abutting ends: Rock face.

2.3 COLD-APPLIED JOINT SEALANTS

- 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. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type NS.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine surfaces indicated to receive stone walls, with Installer present, 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. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
- B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

3.3 INSTALLATION

- A. Do not use stone with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

3.4 JOINT TREATMENT

- A. Joints between wall units shall be hand tight and shall be uniform in thickness. Joint thickness shall typically be 1/8 inch and shall not exceed 3/16 inch.
- B. Seal joints.

3.5 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint sealants using proven techniques that comply with the following:
 - 1. Place joint sealants so they fully contact 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.
- D. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements 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 joint sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- E. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.6 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace stone walls that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.
- B. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- C. 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 in repaired areas are indistinguishable from the original work.
- D. After completion of stone walls, surfaces shall be carefully cleaned, removing all dirt, excess mortar, filler, and stains.

END OF SECTION

**SECTION 32 33 00
SITE FURNISHINGS**

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. Bollards
 - 2. Bicycle racks.
 - 3. Litter and recycling receptacles.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-In-Place Concrete" for foundations for site furnishings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Samples for Verification: For each type of exposed finish, not less than 6-inch- long linear components and 4-inch- square sheet components.
- D. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For site furnishings.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

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. Trash Receptacle Inner Containers: one full-size unit for each size indicated.
 - 2. Anchors: Two units for each type indicated.

PART 2 - PRODUCTS

2.1 BOLLARDS

- A. Basis-of-Design:
 - 1. Manufacturer: Streetlife. Phone: (215) 247-0148. Email: usa@streetlife.com.
 - 2. Product: R&R-BOL – Rough & Ready Ground Mounted Bollard, 30-inch Height.
 - 3. Materials: FSC Hardwood-II Virgin and Corten Steel with Anti-washout coating applied.
 - 4. Mounting: Embedded per manufacturer's recommendations.
 - 5. Quantity: 2.

2.2 BIKE RACKS

- A. Basis-of-Design:
 - 1. Manufacturer: Streetlife. Phone: (215) 247-0148. Email: usa@streetlife.com.
 - 2. Product: SOL-BP - Solid Bike Rack, 28-inch Length.
 - 3. Materials: FSC Hardwood-II Virgin and Corten Steel with Anti-washout coating applied.
 - 4. Mounting: Embedded per manufacturer's recommendations.
 - 5. Quantity: 6.

2.3 LITTER AND RECYCLING RECEPTACLES

- A. Basis-of-Design:
 - 1. Manufacturer: Streetlife. Phone: (215) 247-0148. Email: usa@streetlife.com.
 - 2. Product: BB-S40 - Box Bin Extra Slim with Rain Cover Litter Bin and Recycling Bin with laser-cut signage denoting "Litter".

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3. Materials: Corten Steel with Anti-washout coating applied.
4. Mounting: Surface mounted per manufacturer's recommendations.
5. Options: Provide litter or recycle logos to match existing logos.
6. Quantity: 2 litter; 2 recycle.

2.4 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:

1. Rolled or Cold-Finished Bars, Rods, and Wire: ASTM B 211.
2. Extruded Bars, Rods, Wire, Profiles, and Tubes: ASTM B 221.
3. Structural Pipe and Tube: ASTM B 429/B 429M.
4. Sheet and Plate: ASTM B 209.
5. Castings: ASTM B 26/B 26M.

- B. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.
5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.
6. Perforated Metal: From steel sheet not less than 0.090-inch nominal thickness; manufacturer's standard perforation pattern.
7. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F 1267.
8. Malleable-Iron Castings: ASTM A 47/A 47M, grade as recommended by fabricator for type of use intended.
9. Gray-Iron Castings: ASTM A 48/A 48M, Class 200.

- C. Stainless Steel: Free of surface blemishes and complying with the following:

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1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
 2. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312M.
 3. Tubing: ASTM A 554.
- D. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials; commercial quality, tamperproof, vandal and theft resistant.

2.5 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.6 GENERAL FINISH REQUIREMENTS

- A. 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 ALUMINUM FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for

surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.8 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.
- B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

2.9 IRON FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.10 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. Manufacturer's standard finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

3.3 ADJUSTING

- A. Finish Damage: Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.
- B. Component Damage: Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.4 CLEANING

- A. Clean furnishings promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage finish.

3.5 PROTECTION

- A. Protect installed furnishings to ensure that, except for normal weathering, furnishings will be without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 32 91 13
PLANTING SOILS

PART 1 - GENERAL

1.1 GENERAL PROVISION

- A. Contract Documents and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The work of this Section consists of providing all labor, equipment, materials, incidental work, and construction methods necessary to provide and place planting soils as indicated on the Contract Documents and as specified in this Section.
 - 1. Mixing, amending and manufacturing planting soils from base components.
 - 2. Soil testing.
 - 3. Placing, spreading and grading of planting soil.

1.3 RELATED SECTIONS

- A. The following items of related work are specified and included in other Sections of the Specifications:
 - 1. Section 32 92 00 "Turf and Grasses" for turf mix and installation.
 - 2. Section 32 93 00 "Plants" for trees, shrubs, ground covers, and other plants.

1.4 DEFINITIONS

- A. Planting Soils: The lawn and planting soils consist of a blend of natural topsoil without admixture of subsoil, stripped from the project site, and organic material. Do not mix subsoil with topsoil. The existing topsoil stripped from the Site requires testing after stockpiling to determine the proportion of soil amendments required to meet Specification Requirements.
 - 1. Base Components:
 - a. Base topsoil is a natural growing medium, either stripped from the Site or from other off-site sources.
 - b. Uniform Sand is uniformly graded medium to coarse Uniform Sand.

- c. Organic Material is fully decomposed organic material.

1.5 SUBMITTALS

- A. At least 30 days prior to ordering materials, the Contractor shall submit to the Architect representative samples, certifications, manufacturer's product data and certified test results for materials as specified below for approval. No materials shall be ordered or delivered until the required submittals have been reviewed and approved by the Architect. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Architect reserves the right to reject, on or after delivery, any material that does not meet these specifications.
- B. Topsoil:
 - 1. Existing On-Site Topsoil: Sample and test existing on-site topsoil.
 - 2. The Contractor shall provide a one cubic foot representative sample per each 1,000 cubic yard on-site stockpile of existing topsoil for testing. All stockpile sampling shall be per ASTM D 75 and Appendixes for securing samples from stockpiles.
 - 3. Testing will be at the Contractor's expense. Contractor shall deliver all samples to testing laboratories via overnight courier and shall have the testing report sent directly to the Architect. Perform all tests for gradation, organic content, soil chemistry and pH by Spectrum Analytic, Inc., 1087 Jamison Road NW, Washington CH, OH 43160; (740) 335-1562.
 - 4. Testing reports shall be dated within 30 days of submission to the Architect. Testing reports beyond 30 days old will be rejected and new testing reports mandated.
 - 5. Testing reports shall include the following tests and recommendations. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the Architect from the testing agency. Testing reports shall include the following tests and recommendations.
 - a. Mechanical gradation (sieve analysis) shall be performed and compared to the USDA Soil Classification System. Sieve analysis shall be by combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D 422 after destruction of organic matter by H₂O₂. To facilitate review and approval of sieve analysis, provide a computer-generated gradation curve from testing agency.

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- b. Percent of organics shall be determined by the loss on ignition of oven-dried samples. Test samples minus #10 material shall be oven-dried to a constant weight at a temperature of 450 degrees Fahrenheit (752 degrees Centigrade).
- c. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, extractable Aluminum, Lead, Zinc, Cadmium, Copper, Soluble Salts, and pH and buffer pH. A Conductivity Meter shall be used to measure Soluble Salts in 1:2 soil/water (v/v). Except where otherwise noted, nutrient tests shall be for available nutrients.
- d. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for additives necessary to accomplish turf and planting work as specified.

C. Soil amendments:

1. Submit

- a. Acidulant: Submit supplier's certification that the acidulant being supplied conforms to these specifications.
- b. Fertilizer: Submit product data of seeding and planting fertilizer and certificates showing composition and analysis. Submit fertilization rates for fertilizer product based upon soil testing, analysis, and recommendations.

- 2. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.
- 3. Test for agricultural suitability analysis including: Particle size and characteristics, and pH.

1.6 EXAMINATION OF CONDITIONS

- A. The Contractor shall be solely responsible for judging the full extent of work requirements involved, including but not limited to sampling and testing of on-site stockpiles of delivered off-site loam borrow prior to final planting installation.

1.7 SITE CONDITIONS

- A. Soil Moisture Content

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1. Contractor shall not move, blend or grade soil when moisture content is so great that adequate mixing is not possible, nor when it is so dry that dust will form in the air or that clods will not break readily, nor when it is frozen. Apply water, if necessary, or allow soil to dry to bring soil moisture between 60% of optimum moisture content as determined by ASTM D698 for compaction, grading and plantings.
2. Soil may not be manipulated in any way while in a wet condition, including moving of stockpiles, grading, planting or any other excavation. Contractor is responsible for removal and replacement of any and all soils that were manipulated when wet.
3. Field Soil Moisture Test
 - a. Form soil in palm of hand, if soil retains shape and crumbles upon touching, the soil may be worked.
 - b. If the soil will not retain shape it is too dry and should not be worked.
 - c. If the soil retains shape and will not crumble, it is too wet and should not be worked.
 - d. If the soil glistens or free water is observed when the sample is patted in the palm of hand the soil is too wet and should not be worked.

PART 2 - PRODUCTS**2.1 TOPSOIL – GENERAL**

- A. The Contractor is responsible for balancing the site earthwork by importing, exporting, or amending onsite topsoil as necessary to achieve design grades and specifications.
- B. On-site Soils
 1. Topsoil stockpiled from on-site stripping shall be utilized for reuse.
 2. Amend all topsoil on site by mixing with sand and compost to manufacture specified soil mixes.
- C. Additional topsoil:
 1. In the event that there is an insufficient amount of on-site topsoil to complete the project, additional topsoil from off-site sources shall be provided for mixing with sand and compost to manufacture the specified soil mixes. Any amendments used to manufacture a soil to be imported shall meet the specifications defined in this section.

2.2 AMENDED TOPSOIL FOR GENERAL USE

- A. The on-site soil or any imported topsoil shall be amended with the specified sand or compost to produce a soil meeting the following criterion, as determined by ASTM F1632 or D422:
1. Sand: (0.05 to 2.0 mm) 65 – 75% with at least 50% of the total sand falling into the medium and coarse sand fractions and no more than 25% of the total sand in the fine and very fine sand fractions.
 2. Silt: (0.002 to 0.05 mm) 15 - 25%
 3. Clay: (< 0.002) 5 - 15%
 4. Gravel: (> 2.0 mm) < 15%
- a. Maximum size shall be three eighths (3/8") inches largest diameter.

For bidding purposes, topsoil, sand and compost, each as specified in this Section, shall be combined in an approximate mix ratio of 1 part by volume of sand to one part by volume of on-site topsoil to one part by volume of compost (1S:1TS:1C). Final mix ratios to be determined by the Contractor and shall meet the requirements of this Section.

- B. The amended soil shall have an organic matter content of 4 to 6% (by weight) as determined by ASTM F1647. For bidding purposes, the amount of compost required to increase the organic matter content to meet the specifications can range from 30 to 50% by volume, depending on the quality of the compost.
- C. Ratio of the particle size for 80% passing (D₈₀) to the particle size for 30% passing (D₃₀) shall be 5.5 or less. (D₈₀/D₃₀ < 8)
- D. The amended soil shall have a minimum percolation rate of 0.50-inch per hour with the soil compacted to 88% of maximum standard proctor density (ASTM D698).
- E. The amended soil shall have a pH between 6 – 8.
- F. The topsoil meeting this specification shall serve as the baseline for subsequent quality control testing. Samples shall be taken every 1,000 cubic yards prior to placement for conformity to the specifications. Quality control testing shall include organic matter content and particle size analysis.
- G. The final soil mix shall be submitted to testing agency to determine the fertility status of the soil.

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2.3 SOIL ADDITIVES

- A. General: Soil additives shall be used to counteract soil deficiencies as recommended by the soils analysis and as supplements for turf construction as specified herein.
- B. Acidulant for adjustment of loam borrow pH shall be commercial grade flours of sulfur, ferrous sulfate, or aluminum sulfate that are unadulterated. Acidulants shall be delivered in unopened containers with the name of the manufacturer, material, analysis and net weight appearing on each container.
- C. Ground limestone for adjustment of loam borrow pH shall contain not less than 85 percent of total carbonates and shall be ground to such fineness that 40 percent will pass through 100 mesh sieve and 95 percent will pass through a 20 mesh sieve. Contractor shall be aware of loam borrow pH and the amount of lime needed to adjust pH to meet the requirements of the testing lab recommendations.
- D. The compost used to amend the soil shall be well decomposed, stable, mature, aerobically composted product utilizing feedstock from yard wastes, food wastes, biosolids, or any combination of these. The compost shall meet the following criteria:
 - 1. An organic matter content of no less than 35% as determined by ASTM D2974.
 - 2. A moisture content of 35 – 70%, as determined by ASTM D2974.
 - 3. A carbon/nitrogen ratio of 15:1 to 30:1.
 - 4. Soluble salts not to exceed 2 dS/m.
 - 5. A Solvita Index of 5 to 8.
 - 6. 95 – 100% passing a 3/8" screen.
 - 7. A pH of 6 to 8.
 - 8. Non-phytotoxic.
 - 9. All EPA and state regulations for biosolid composts.

The Contractor shall submit representative samples of organic matter amendment they intend to bring onto the site to the owners testing agent. All reports shall be sent to the Architect for approval.

- E. Sand shall be blended into the topsoil in the proper amount to achieve the particle size distribution described in these specifications. Sand for use as a soil amendment shall be a washed natural or classified sand meeting the following particle size distribution as determined by ASTM C-136 or F1632.

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<u>Sieve</u>	<u>Sieve Size</u>	<u>% Passing</u>
No. 4	4.75 mm	100%
No. 8	2.38 mm	90 - 100%
No. 16	1.19 mm	80 - 100%
No. 30	0.60 mm	25 - 60
No. 50	0.30 mm	0 - 25%
No. 100	0.15 mm	0 - 5
No. 270	0.075 mm	0 - 3

In addition, the sand shall have a coefficient of uniformity (D60/D10) of less than 4.0.

- F. Commercial fertilizer shall be a product complying with the State and United States fertilizer laws. Deliver fertilizer to the site in the original unopened containers bearing the manufacturer's certificate of compliance covering analysis and which shall be furnished to the Architect. Fertilizer shall contain not less than the percentages of weight of ingredients as recommended by the soil analysis.
1. Fertilizer for planting shall be formulated for top-dressing, soil surface application to plants. Fertilizer shall be designed and certified by the manufacturer to provide controlled release of fertilizer continuously for not less than 9 months. One hundred percent of the nitrogen content shall be derived from organic materials. Nitrogen source shall be coated to ensure slow release. Fertilizer percentages of weight of ingredients shall be as recommended by the soil testing and analysis specified herein.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Verification of Conditions: in the event field conditions are not as shown on Drawings and outlined in the specifications, notify Owner's Representative in writing.
1. Spot and Invert Elevations: Verify field elevations of site improvements such as drainage and utility fixtures, pavements, existing plantings, and subsurface piping conform to Drawings.
 2. Rough grade: verify specified elevations and prior earthwork operations have shaped, trimmed, and finished rough grade.

3.2 PREPARATION

- A. Protection:

1. Contractor shall be required to clear working areas with Ohio Utility Protection Service prior to doing excavation on site. If work is to be done around underground utilities, appropriate authority of utility must be notified of impending work. Hand excavate areas adjacent to utilities. Contractor shall be responsible for damages done by himself or his personnel to existing utilities, which shall be repaired or paid for by Contractor.

3.3 MIXING PLANTING SOIL

- A. Soil additives shall be thoroughly incorporated into planting soil by harrowing or other methods standard to the industry.
- B. Correct deficiencies in soil as directed by horticultural soil test results. Thoroughly incorporate amendments into planting mixture to ensure even distribution.

3.4 FILLING AND COMPACTION

- A. Perform percolation tests on existing sub-soils or placed fill prior to placing and spreading planting soils (this requirement is waived where there is under drain perforated piping):
 1. Perform percolation testing of subsoil or placed fills to determine whether or not the subgrade will drain properly. Perform percolation tests as specified in this Section - for each lift of loam borrow.
 2. In the event that percolation testing indicates that the subsoil, placed fills or ordinary borrow has been over compacted and will not drain, the contractor shall loosen up the top 12 inches of the subgrade to be planted and seeded by ripping or other mechanical means. Re-compact the borrow by driving a small, tracked bulldozer over the area at low speeds so that the tracks of the bulldozer pass over the affected area and the soil is compacted to a density that will percolate. Under no circumstances shall wheeled vehicles be driven over subsoil, placed fills or ordinary borrow that have been shown to percolate or subsoil, placed fills or ordinary borrow that has been loosened and shown to percolate.
 3. Perform sufficient percolation tests in areas of poorly draining or compacted subsoil or compacted placed fills as directed by the Architect to ensure that these underlying soils drain. Likewise, perform sufficient percolation tests after ripping and loosening to ensure that the soils are no longer too compact to drain.

- B. Do not damage the work previously installed. Maintain all required angles of repose of materials adjacent to the loam as shown on the Drawings. Do not over excavate compacted subgrades of adjacent pavement or structures during loaming operations.
- C. Confirm that the subgrade is at the proper elevation and that no further earthwork is required to bring the subgrade to proper elevations. Subgrade elevations shall slope parallel to the finished grade and or toward the subsurface drain lines as shown on the Drawings.
- D. Clear the subgrade of all construction debris, trash, rubble and any foreign material. In the event that fuels, oils, concrete washout or other material harmful to plants have been spilled into the subgrade material, excavate the soil sufficiently to remove the harmful material. Such construction debris, trash, rubble and foreign material shall be removed from the site and disposed of in a legal manner. Fill any over excavation with approved fill and compact to the required subgrade compaction levels.
- E. Do not proceed with the installation of amended topsoil until all utility work in the area has been installed.
- F. Protect adjacent walls, walks and utilities from damage or staining by the soils. Use 0.5-inch plywood and or plastic sheeting as directed to cover existing concrete, metal and masonry work and other items as directed during the progress of the work. Clean up all trash and any soil or dirt spilled on any paved surface at the end of each working day.

3.5 SOIL VOLUMES

- A. Plant soil volumes required as follows:
 - 1. Planting soil depth for tree pits shall be 30 inches by three times the diameter of the root ball.
 - 2. Planting soil depth for plant beds containing shrubs, perennials, ornamental grasses, and groundcover shall be 12 inches.
 - 3. Planting soil depth for turf areas shall be 6 inches.

3.6 FINE GRADING

- A. Immediately prior to dumping and spreading loam borrow, the subgrade shall be cleaned of all stones greater than 2 inches in any dimension and all debris or rubbish. Such material shall be removed from the site, not raked to the edges and buried. Notify the Architect that the subsoil has been cleaned and request his/her attendance on site to review and approve subgrade conditions prior to spreading loam borrow.

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- B. Notify the Architect when the amended topsoil is scheduled for placement and schedule his/her attendance on site to witness delivery and stockpiling. Architect will inspect the amended topsoil for conformance to the requirements of this Section.
- C. Amended topsoil shall be protected from erosion at all times. Materials shall be spread immediately upon approval soil test reports. Otherwise, materials that set on site for more than 24 hours shall be covered with tarpaulin or other soil erosion system acceptable to the Architect and surrounded by silt fence.
- D. Place amended topsoil in two lifts. Place the first lift to a depth of 2 inches and harrow or till the loam into the underlying subsoil to a depth of 2 inches, creating a blended interface of loam and subsoil approximately 4 inches deep. Spread the second lift of loam to a minimum depth of 4 inches or greater as shown on the Drawings.
- E. No loam borrow shall be handled, planted, or seeded in any way if it is in a wet or frozen condition. A moist loam borrow is desirable.
- F. Fertilizer shall be spread and thoroughly incorporated into the top layer of the amended topsoil by harrowing or other method reviewed by the Architect. Fertilizer shall be applied at the rate recommend by the soil analysis.
- G. Remove all large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove from unscreened soils all stones over 1 inch in ay dimension from the top 6 inches of the amended topsoil bed. Amended topsoil shall also be free of smaller stones in excessive quantities as determined by the Architect.
- H. The Contractor shall install amended topsoil in successive horizontal lifts no thicker than 6 inches in turf areas and 12 inches in plant bed areas to the desired compaction as described herein. The Contractor shall install the soil at a higher level to anticipate any reduction of amended topsoil volume due to compaction, settling, erosion, decomposition, and other similar processes during the warranty period. The Architect will ensure that the full depths of amended topsoil for turf and plant beds are obtained by digging holes in the amended topsoil at the same frequency as for compaction testing.
 - 1. Compact planting soil to the required density as specified herein.
 - 2. Maximum dry density planting soil shall be determined in accordance with ASTM D698. The following percentages of minimum to maximum dry densities shall be achieved for amended topsoil.

In turf, plant beds and tree pits:

	<u>Minimum</u>	<u>Maximum</u>
a. Fills within turf and planting areas in top 86% eighteen inches of finished grade	83%	
3. The surface area of each lift shall be scarified by raking prior to placing the next lift.
- I. Compaction:
 1. For amended topsoil for general use in turf and plant beds, compact each lift sufficiently to reduce settling but not enough to prevent the movement of water and feeder roots through the soil. The amended topsoil in each lift should feel firm to the foot in all areas and make only slight heel prints. At completion of the loam borrow installation, the soil should offer a firm, even resistance when a soil sampling tube is inserted from lift to lift.
 - J. Percolation test procedure:
 1. Dig a hole in the installed soil that is a minimum of 4 inches in diameter. Holes in 6-inch lift in turf areas shall be 4 inches deep. Holes in 12-inch lifts in plant beds shall be 8 inches deep. Do not penetrate through the lift being tested.
 2. Fill the hole with water and let it drain completely. Immediately refill the hole with water and measure the rate of fall in the water level.
 3. In the event that the water drains at a rate less than one inch per hour, till the soil to a depth required to break the over compaction.
 4. Perform a minimum of one soil percolation test per 10,000 square feet area of turf area and 2,500 square feet of tree and shrub planting area as directed by the Architect.
 5. Do not spread any amended topsoil for general use until placed materials have been tested for percolation rates.
 - K. Select equipment and otherwise phase the installation of the amended topsoil to ensure that wheeled equipment does not travel over subsoil, placed fills or ordinary borrow or already installed soil. Movement of tracked equipment over said soils will be reviewed and considered for approval by the Architect. If it is determined by the Architect that wheeled equipment must travel over already installed soil, provide a written description of sequencing of work that ensures that compacted soil is loosened

and un-compacted as the work progresses or place one-inch thick steel plate ballast (or equivalent ballast approved by the Architect) over the length and width of any travel way to cover loam borrow to protect it from compaction.

- L. Disturbed areas outside the limit of turf work shall be graded smooth and spread with a minimum of 6 inches of loam borrow to the finished grade.

3.7 CLEANING

- A. Clean up debris generated under work of this section.
- B. Site Improvements
 - 1. Wash and sweep clean site improvements such as drainage and utility fixtures, pavements, existing plantings, and site furnishings.

3.8 PROTECTION

- A. Protect work of this section until Final Acceptance.
- B. Protect prepared soils from compaction by construction traffic and from contamination by construction materials and from saturation.

3.9 ACCEPTANCE

- A. Confirm that the final grade of the loam borrow is at the proper finish grade elevations. Adjust grade as required to meet the contours and spot elevations noted on the Drawings. Request the presence of the Architect to inspect final grade. Do not proceed with the remaining work of this Contract until the Architect has given his/her written approval of the final grade.

END OF SECTION

**SECTION 32 92 00
TURF AND GRASSES**

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. Seeding.
 - 2. Hydroseeding.
 - 3. Meadow grasses and wildflowers.
 - 4. Turf renovation.
 - 5. Erosion-control material(s).
- B. Related Requirements:
 - 1. Section 32 91 13 "Planting Soils" for soil mix and installation.
 - 2. Section 32 93 00 "Plants" for trees, shrubs, ground covers, and other plants.

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

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- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 91 13 "Planting Soils."
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, 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.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf and meadow establishment.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."

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3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in all of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Lawncare Manager.
 - c. Landscape Industry Certified Lawncare Technician.
5. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Bulk Materials:
 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or 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 materials with appropriate certificates.

1.9 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.
 1. Turf Grass:
 - a. Spring Planting: March 15 to June 1.
 - b. Fall Planting: August 15 to October 15.
 2. Meadow:

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- a. Spring Planting: March 15 to June 15.
 - b. Fall Planting: September 15 to November 1.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS**2.1 SEED**

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Mix: Seed of grass species as follows, with not less than 85 percent germination, not less than 98 percent pure seed, and completely free of noxious weeds and grasses. The mixture shall be as follows or an approved equal: (Mixture shall rate in NTEP's top ten. Contractor to provide information on grass seed stating it meets NTEP's top ten list)
- 1. 80-90 percent Turf-type Tall Fescue consisting of minimum 3 varieties (15 percent minimum for any variety).
 - 2. 5-10 percent Perennial Ryegrass.
 - 3. 5-10 percent Kentucky Bluegrass.

2.2 MEADOW MIX

- A. Native-Grass Seed: Fresh, clean, and dry new seed, of mixed species as follows:
- 1. Manufacturer: Ohio Prairie Nursery
 - 2. Seed Mix: Native Short Grass and Wildflower Seed Mix.
- B. Seed Carrier: Rice Hulls.
- C. Cover Crop: Annual Rye Grass.

2.3 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of quick release nitrogen source, phosphate, and potash. Apply nitrogen,

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phosphate and potash in the amounts recommended in the soil reports from a qualified testing agency.

- B. Slow-Release Fertilizer: Granular fertilizer consisting of a minimum of 50 percent water-insoluble nitrogen or coated nitrogen source, phosphate, and potash. Apply nitrogen, phosphate and potash in the amounts recommended in the soil reports from a qualified testing agency.

2.4 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.5 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 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 long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 - 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. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- 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 as directed by Architect 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 adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Install 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 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 91 13 "Planting Soils."
- B. Placing Planting Soil: Place and mix planting soil per section 32 91 13 "Planting Soils."

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- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. Prepare area as specified in "Turf Area Preparation" Article.
- B. For erosion-control blanket or mesh, install from top of slope, working downward, and 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 TURF SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
 - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 6 to 8 lb/1000 sq. ft..
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

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- F. Overseed turf area eight (8) weeks after initial seeding operation at a rate of 5 lbs/1000 sq. ft., if initial seeding has not provided a minimum of 90% coverage over any 10 sq. ft., or if bare areas greater the 3 by 3 inches are present.

3.6 TURF HYDROSEEDING

- A. Hydroseeding: Mix specified seed, commercial fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with nonasphaltic tackifier.
 - 2. Spray-apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

3.7 TURF RENOVATION

- A. Renovate existing turf where indicated.
- B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 - 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 - 2. Install new planting soil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- E. Mow, dethatch, core aerate, and rake existing turf.
- F. Remove weeds before seeding. Where weeds are extensive, 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.

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- I. Apply initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
 - 1. Initial Fertilizer: Commercial fertilizer applied according to manufacturer's recommendations.
- J. Apply seed and protect with straw mulch as required for new turf.
- K. Water newly planted areas and keep moist until new turf is established.

3.8 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf 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 turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay

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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. Mow turf to a height of 2 to 3 inches.

- D. Turf Post-fertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of 1 lb/1000 sq. ft. to turf area.
2. 2nd application fertilizer: Apply six (6) weeks after seeding operations. Provide a high nitrogen slow-release fertilizer with an analysis of 30-3-10 or similar. Apply at a rate to provide actual nitrogen of 1 lb/1000 sq. ft. to turf area.

3.9 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: 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. and bare spots not exceeding 5 by 5 inches.

- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.10 MEADOW

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

1. Before sowing, mix seed with seed carrier and cover crop at a ratio of not less than four parts seed carrier to one part seed.
2. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
3. Do not use wet seed or seed that is moldy or otherwise damaged.

- B. Sow seed at a rate of 15 PLS lb/acre with 10 PLS lb/acre of cover crop.

- C. Brush seed into top 1/16 inch of soil, roll lightly, and water with fine spray.

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- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
- F. Water newly planted areas and keep moist until meadow is established.

3.11 MEADOW MAINTENANCE

- A. Maintain and establish meadow by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish a healthy, viable meadow. Roll, regrade, and replant bare or eroded areas and remulch. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and meadow damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep meadow and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and meadow-watering equipment to convey water from sources and to keep meadow uniformly moist.
 - 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 meadow with fine spray at a minimum rate of 1/2 inch per week for eight weeks after planting unless rainfall precipitation is adequate.

3.12 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.13 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. 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 plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

3.14 MAINTENANCE SERVICE

- A. Turf and Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
 - 1. Seeded Turf: 90 days from date of Substantial Completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
 - 2. Meadow Maintenance Period: 90 days from date of Substantial Completion.

END OF SECTION

SECTION 32 93 00

PLANTS

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. Plants.
 - 2. Tree stabilization.
 - 3. Tree-watering devices.
- B. Related Requirements:
 - 1. Section 32 91 13 "Planting Soils" for plant soil mix and installation.
 - 2. Section 32 92 00 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a 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 plant required.
- D. Finish Grade: Elevation of finished surface of planting soil.

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- E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- F. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- G. Planting Area: Areas to be planted.
- H. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 91 13 "Planting Soils."
- I. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- J. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- K. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- L. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

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1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- B. Samples for Verification: For each of the following:
 - 1. Organic Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
 - 2. Slow-Release, Tree-Watering Device: One unit of each size required.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis of standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
- D. Sample Warranty: For special warranty.

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1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Experience: Five years' experience in landscape installation in addition to requirements in Section 01 40 00 "Quality Requirements."
 - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 4. Personnel Certifications: Installer's field supervisor shall have certification in all of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Horticultural Technician.
 - 5. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
 - 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
 - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

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- D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or 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 materials with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, 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 plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. 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.
- F. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

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1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.11 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 1. Spring Planting: March 15 to June 1.
 2. Fall Planting: September 1 to November 1.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

- A. Special Warranty: 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 abuse, lack of adequate maintenance, or neglect by Owner.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

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2. Warranty Periods: From date of Substantial Completion.
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS**2.1 PLANT MATERIAL**

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

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- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.
- E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 FERTILIZERS

- A. Fertilizer: Refer to Section 32 91 13 "Planting Soils."

2.3 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 - 1. Type: Double-shredded hardwood.
 - 2. Size Range: 3 inches maximum, 1/2 inch minimum.
 - 3. Color: Natural.

2.4 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.5 TREE-STABILIZATION MATERIALS**A. Trunk-Stabilization Materials:**

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, 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, two-strand, twisted, 0.106 inch in diameter.
4. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
5. Guy Cables: Five-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.

2.6 TREE-WATERING DEVICES

- A. Slow-Release Watering Device:** Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.
1. Product: Treegator Original Slow Release Watering Bag
 2. Color: Green.

2.7 MISCELLANEOUS PRODUCTS

- A. Burlap:** Non-synthetic, biodegradable.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.**

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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. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
 3. Suspend planting 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 that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install 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 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 91 13 "Planting Soils."
- B. Placing Planting Soil: Place and mix planting soil according to Section 32 91 13 "Planting Soils."
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom

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leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

2. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.
 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 6. Maintain supervision of excavations during working hours.
 7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
1. Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
 2. Fill planting pit with water and verify that it drains.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from

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the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
 - 1. Backfill: Planting soil per Section 32 91 13 "Planting Soils."
 - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
 - 1. Backfill: Planting soil per Section 32 91 13 "Planting Soils."
 - 2. Carefully remove root ball from container without damaging root ball or plant.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

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3.6 MECHANIZED TREE-SPADE PLANTING

- A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.
- B. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.
- C. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.
- D. Cut exposed roots cleanly during transplanting operations.
- E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.
- F. Where possible, orient the tree in the same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Do not apply pruning paint to wounds.

3.8 TREE STABILIZATION

- A. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings. Stake and guy trees more than 12 feet in height and more than 3 inches in caliper unless otherwise indicated.
 - 1. Site-Fabricated, Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.
 - a. Securely attach guys to stakes 36 inches long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle for each guy wire and tighten securely.
 - b. 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.
 - c. Support trees with guy cable or multiple strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk

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and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.

- d. Attach flags to each guy wire, 30 inches above finish grade.

3.9 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.
- B. Use planting soil per Section 32 91 13 "Planting Soils" for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 1. Trees in Turf Areas: Apply organic mulch ring of 2-inch average thickness, with 18-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
 2. Organic Mulch in Planting Areas: Apply 2-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.11 EDGING INSTALLATION

- A. Shovel-Cut Edging: Separate mulched areas from turf areas, curbs, and paving with a 45-degree, 4- to 6-inch-deep, shovel-cut edge.

3.12 INSTALLING SLOW-RELEASE WATERING DEVICE

- A. Provide one device for each tree.

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- B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.13 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.14 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.15 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.

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3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
 1. Provide new plants of same size and species as those being replaced.

3.16 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before project completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.17 MAINTENANCE SERVICE

- A. Maintenance Service for Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 1. Maintenance Period: 12 months from date of Substantial Completion.

END OF SECTION

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

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. This Section includes water-distribution piping and related components outside the building for water service, fire-service mains, and combined water service and fire-service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.

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2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- F. NSF Compliance:
1. Comply with NSF 14 for plastic potable-water-service piping.
 2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
1. Ensure that valves are dry and internally protected against rust and corrosion.
 2. Protect valves against damage to threaded ends and flange faces.
 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

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- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping 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.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution 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 water-distribution service according to requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Architect's written permission.

1.9 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS**2.1 COPPER TUBE AND FITTINGS**

- A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.
 - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 - 2. Copper, Pressure-Seal Fittings:

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- a. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - b. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- B. Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper.
 - 1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
 - 2. Copper, Pressure-Seal Fittings:
 - a. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - b. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, Class 52, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, Class 52, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.

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- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, Class 52, with cut, rounded-grooved ends.
 - 1. Grooved-End, Ductile-Iron Pipe Appurtenances:
 - a. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 - b. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- D. Flanges: ASME 16.1, Class 125, cast iron.

2.3 PE PIPE AND FITTINGS

- A. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG Class 200.
 - 1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

2.4 PVC PIPE AND FITTINGS

- A. PVC, AWWA Pipe: AWWA C900, Class 200, with bell end with gasket, and with spigot end.
 - 1. Comply with UL 1285 for fire-service mains if indicated.
 - 2. PVC Fabricated Fittings: AWWA C900, Class 200, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
 - 4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.
 - 5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

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- a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.5 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, BCuP Series.
- B. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
- C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.6 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
 1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
 - a. Standard: AWWA C219.

2.7 CORROSION-PROTECTION PIPING ENCASEMENT

- A. Encasement for Underground Metal Piping:
 1. Standards: ASTM A 674 or AWWA C105.
 2. Form: Sheet.
 3. Material: LLDPE film of 0.008-inch minimum thickness.
 4. Color: Black.

2.8 GATE VALVES

- A. AWWA, Cast-Iron Gate Valves:
 1. Nonrising-Stem, Resilient-Seated Gate Valves:

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- a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.
- 2. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Flanged.
- B. UL/FMG, Cast-Iron Gate Valves:
 - 1. UL/FMG, Nonrising-Stem Gate Valves:
 - a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Flanged.
 - 2. OS&Y, Rising-Stem Gate Valves:
 - a. Description: Iron body and bonnet and bronze seating material.
 - 1) Standards: UL 262 and FMG approved.
 - 2) Minimum Pressure Rating: 200 psig.
 - 3) End Connections: Flanged.

2.9 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:

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1. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.10 DETECTOR CHECK VALVES

- A. Detector Check Valves:
 1. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
 - a. Standards: UL 312 and FMG approved.
 - b. Pressure Rating: 200 psig.
 - c. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

2. Description: Iron body, corrosion-resistant clapper ring and seat ring material, flanged ends, with connections for bypass and installation of water meter.
 - a. Standards: UL 312 and FMG approved.
 - b. Pressure Rating: 200 psig.

2.11 CORPORATION VALVES AND CURB VALVES

- A. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- B. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.12 WATER METERS

- A. Water meters will be furnished by utility company.

2.13 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
 1. Standard: ASSE 1013.
 2. Operation: Continuous-pressure applications.

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- B. Double-Check, Backflow-Prevention Assemblies:
 - 1. Standard: ASSE 1015.
 - 2. Operation: Continuous-pressure applications, unless otherwise indicated.
- C. Reduced-Pressure-Detector, Fire-Protection Backflow Preventer Assemblies:
 - 1. Standards: ASSE 1047 and UL listed or FMG approved.
 - 2. Operation: Continuous-pressure applications.
- D. Double-Check, Detector-Assembly Backflow Preventers:
 - 1. Standards: ASSE 1048 and UL listed or FMG approved.
 - 2. Operation: Continuous-pressure applications.

2.14 WATER METER BOXES

- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.
 - 1. Option: Base section may be cast-iron, PVC, clay, or other pipe.
- B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.
- C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10 by 10 inches square.

2.15 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.
 - 1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
 - 2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.

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- a. Dimension: 24-inch minimum diameter, unless otherwise indicated.
- 3. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.16 PROTECTIVE ENCLOSURES**A. Freeze-Protection Enclosures:**

- 1. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 deg F when external temperatures reach as low as minus 34 deg F.
 - a. Standard: ASSE 1060.
 - b. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
 - 1) Housing: Reinforced aluminum or fiberglass construction.
 - a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
 - b) Drain opening for units with drain connection.
 - c) Access doors with locking devices.
 - d) Insulation inside housing.
 - e) Anchoring devices for attaching housing to concrete base.
 - 2) Electric heating cable or heater with self-limiting temperature control.

2.17 FIRE HYDRANTS**A. Dry-Barrel Fire Hydrants:**

- 1. Makes and models as approved by authority having jurisdiction.
- 2. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, 5-1/4-inch main valve, drain valve, and NPS 6 mechanical-joint inlet. Include interior

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coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.

- a. Standard: AWWA C502.
- b. Pressure Rating: 250 psig.
- c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
- d. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.
- e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
- f. Exterior Finish: alkyd-gloss enamel paint in colors required by authority having jurisdiction.

2.18 FIRE DEPARTMENT CONNECTIONS**A. Fire Department Connections:**

- 1. As approved by authority having jurisdiction.
- 2. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- high brass sleeve; and round escutcheon plate.
 - a. Standard: UL 405.
 - b. Connections: Two NPS 2-1/2 inlets and one NPS 4 outlet.
 - c. Inlet Alignment: Inline, horizontal.
 - d. Finish Including Sleeve: Polished chrome plated.
 - e. Escutcheon Plate Marking: "AUTO SPKR"

2.19 ALARM DEVICES

- A. Alarm Devices, General: UL 753 and FMG approved, of types and sizes to mate and match piping and equipment.
- B. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

PART 3 - EXECUTION**3.1 EARTHWORK**

- A. Refer to Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 3/4 to NPS 3 shall be any of the following:
 - 1. Soft copper tube, ASTM B 88, Type K; copper, pressure-seal fittings; and pressure-sealed joints.
 - 2. PE, ASTM pipe; molded PE fittings; and heat-fusion joints.
- F. Underground water-service piping NPS 4 to NPS 12 shall be any of the following:
 - 1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; or grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
 - 2. PE, AWWA pipe; PE, AWWA fittings; and heat-fusion joints.
 - 3. PVC, AWWA Class 200 pipe; PVC, AWWA Class 200 fabricated fittings; and gasketed joints.
- G. Water Meter Box Water-Service Piping NPS 3/4 to NPS 3 shall be same as underground water-service piping.
- H. Aboveground and vault water-service piping NPS 4 to NPS 12 shall be the following:
 - 1. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.
- I. Underground Fire-Service-Main Piping NPS 4 to NPS 12 shall be any of the following:

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1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.
 2. PE, Class 200, fire-service pipe; molded PE fittings; and heat-fusion joints.
 3. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 200 fabricated fittings; and gasketed joints.
- J. Aboveground and Vault Fire-Service-Main Piping NPS 4 to NPS 12 shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
- K. Underground Combined Water-Service and Fire-Service-Main Piping NPS 4 to NPS 12 shall be any of the following:
1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints, or grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.
 2. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.
- L. Aboveground Combined Water Service and Fire-Service-Main Piping NPS 4 to NPS 12 shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
 2. Use the following for valves in vaults and aboveground:
 - a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.

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- b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated.
 - c. Check Valves: AWWA C508, swing type.
- 3. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

3.4 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- B. Make connections larger than NPS 2 with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- C. Make connections NPS 2 and smaller with drilling machine according to the following:
 - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
 - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
 - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
 - 4. Install corporation valves into service-saddle assemblies.
 - 5. Install manifold for multiple taps in water main.
 - 6. Install curb valve in water-service piping with head pointing up and with service box.
- D. Comply with NFPA 24 for fire-service-main piping materials and installation.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.

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2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- E. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- F. Install PE pipe according to ASTM D 2774 and ASTM F 645.
- G. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- H. Bury piping with depth of cover over top at least 48 inches, with top at least 12 inches below level of maximum frost penetration.
- I. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- J. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- K. Sleeves are specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- L. Mechanical sleeve seals are specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- M. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
 2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
5. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
6. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

3.6 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 1. Concrete thrust blocks.
 2. Locking mechanical joints.
 3. Set-screw mechanical retainer glands.
 4. Bolted flanged joints.
 5. Heat-fused joints.
 6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 3. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

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- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.8 DETECTOR-CHECK VALVE INSTALLATION

- A. Install in vault or aboveground.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

3.9 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.
- B. Water Meters: Install displacement-type water meters, NPS 2 and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.
- C. Water Meters: Install compound-type water meters, NPS 3 and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
- D. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets and full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

3.10 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

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- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.12 WATER METER BOX INSTALLATION

- A. Install water meter boxes in paved areas flush with surface.
- B. Install water meter boxes in grass or earth areas with top 1 inch above surface.

3.13 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.14 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
- C. AWWA Fire Hydrants: Comply with AWWA M17.
- D. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.15 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valves at each check valve for fire department connection to mains.
- B. Install protective pipe bollards on three sides of each fire department connection. Pipe bollards are specified in Section 055000 "Metal Fabrications."

3.16 ALARM DEVICE INSTALLATION

- A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
- B. Supervisory Switches: Supervise valves in open position.
 - 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
 - 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.

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- C. Locking and Sealing: Secure unsupervised valves as follows:
 - 1. Valves: Install chain and padlock on open OS&Y gate valve.
 - 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Connect alarm devices to building fire alarm system. Wiring and fire-alarm devices are specified in Section 28 46 21.11 "Addressable Fire-Alarm Systems" and Section 28 46 21.13 "Conventional Fire-Alarm Systems."

3.17 CONNECTIONS

- A. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve or service clamp and corporation valve.
- B. Connect water-distribution piping to interior domestic water and fire-suppression piping.
- C. Connect waste piping from concrete vault drains to storm-drainage system. See Section 334400 "Storm Utility Drainage Piping" for connection to storm-sewer piping.

3.18 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

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3.19 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 31 20 00 "Earth Moving."

3.20 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION 33 31 00

SANITARY SEWERAGE PIPING

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. PVC pipe and fittings.
 - 2. Nonpressure-type transition couplings.
 - 3. Cleanouts.
 - 4. Manholes.
 - 5. Concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe and fittings.
 - 2. Non-pressure and pressure couplings
 - 3. Cleanouts.
- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of pipe and fitting.
- B. Field quality-control reports.

1.5 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.

- C. Handle manholes according to manufacturer's written rigging instructions.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Sewerage 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 requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. PVC Corrugated Smooth Interior Sewer Piping:
 - 1. Pipe: ASTM F 949, PVC corrugated pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
 - 3. Gaskets: ASTM F 477, elastomeric seals.
- B. PVC Profile Sewer Piping:
 - 1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM D 3034, PVC with bell ends. Use only molded or fabricated fittings.
 - 3. Gaskets: ASTM F 477, elastomeric seals.
 - 4. Stiffness: 46 psi or greater.
- C. PVC Type PSM Sewer Piping:
 - 1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM D 3034, PVC with bell ends.

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3. Gaskets: ASTM F 477, elastomeric seals.

D. PVC Gravity Sewer Piping:

1. Pipe and Fittings: ASTM F 679, minimum pipe stiffness of 115 psi, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

F. Nonpressure-Type, Rigid Couplings:

1. Description: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.3 CLEANOUTS

A. PVC Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.4 MANHOLES

A. In accordance with the latest standard drawings from the Ohio Department of Transportation.

B. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.

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10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

C. Designed Precast Concrete Manholes:

1. Description: ASTM C 913; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44 in AASHTO HL), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
5. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
6. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
7. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

D. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser, with 4-inch- minimum-width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."

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2. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48/A 48M, Class 35 gray iron unless otherwise indicated.

2.5 CONCRETE

- A. General: Cast-in-place concrete complying with ACI 318, ACI 350, and the following:
 1. Cement: ASTM C 150/C 150M, Type II.
 2. Fine Aggregate: ASTM C 33/C 33M, sand.
 3. Coarse Aggregate: ASTM C 33/C 33M, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
 1. Reinforcing Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 2 percent through manhole.
 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 8 percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
 1. Reinforcing Fabric: ASTM A1064/A 1064M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

PART 3 - EXECUTION**3.1 EARTHWORK****A. GENERAL:**

1. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 611.02, Type B Conduits.
2. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 611.02, Type C Conduits.

B. Excavation For Utility Trenches:

1. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
2. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
3. Excavate trench walls per ODOT Item 611.05 and geotechnical report as identified on the Drawings.
4. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.

C. Utility Trench Backfill:

1. Place and compact bedding course as required by ODOT specifications Item 611.06 and geotechnical report. Type 2 bedding consists of structural backfill extending at least 3 inches for all ODOT Item 706 rigid pipe conduits and 6 inches for all other conduits below the bottom of the conduit for the full width of the trench. Extend the bedding up around the pipe for a depth of not less than 30 percent of the rise of the conduit. Shape the bedding to fit the conduit with recesses shaped to receive the bell of bell-and-spigot pipe. Leave the bedding below the middle one-third of the pipe span uncompacted. Compact the remaining bedding according to ODOT Item 611.06.
2. Use Type 2 bedding for Types A, B, C, and D conduits except for long span structures and for conduits that require Type 3 bedding.
3. Type 3 bedding consists of a natural foundation with recesses shaped to receive the bell of bell-and-spigot pipe. Scarify and loosen the middle one-third of the pipe span.

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4. Use Type 3 bedding for Type C and Type D conduits of the following materials: ODOT Items 706.01, 706.02, or 706.03.
5. Structural backfill shall consist of #57 limestone and backfilled according to the authority having jurisdiction.
6. Non-structural backfill should consist of clean, inorganic soil free of any miscellaneous materials, cobbles, and boulders. The fill should be placed in uniform, thin lifts and carefully compacted to a unit dry weight equal to 100 percent in structure areas and at least 98 percent of the maximum dry weight below pavement areas. The moisture content of the fill should be maintained at -2 to +1 percent of the optimum moisture content as determined in the laboratory by the Standard Test Methods for Moisture-Density Relations of Soils (ASTM D698). Fill should not be placed in a frozen condition or upon a frozen subgrade.
7. Place backfill to the limits described and according to the compaction requirements of ODOT Item 611.06. Place the backfill in the trench and embankment outside the trench uniformly on both sides of the conduit for all conduit installations.
 - a. Type A and B. Backfill Types A and B conduits except for long span structures as follows
 - 1) In a cut situation, place and compact structural backfill above the bedding for the full depth of the trench. Within the trench and more than 4 feet above the top of the conduit, if the trench can accommodate compaction equipment, the Contractor may construct Item 203 Embankment. For plastic pipe with an ID 8 inch or less, place and compact structural backfill above the bedding for the full depth of the trench.
 - 2) In a fill situation, place and compact structural backfill above the bedding for the full depth of the trench specified in 611.05. Above these limits, uniformly place the lesser of one pipe span or 4 feet of structural backfill on each side of the conduit and to a depth of 2 feet above the top of the conduit. Construct the embankment outside the limits of the backfill. For plastic pipe with an ID 8 inch or less, place and compact structural backfill above the bedding for the full depth of the trench.

b. Type C and D. Backfill Type C and D conduits as follows:

- 1) In a cut situation, for plastic pipe, place and compact structural backfill above the bedding and to 12 inches over the top of the pipe. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch or less, place and compact structural backfill above the bedding for the full depth of the trench.
 - 2) In a fill situation, for plastic pipe, place and compact structural backfill above the bedding for the full depth of the trench specified in 611.05. Above these limits, uniformly place the lesser of one pipe span or 4 feet of structural backfill on each side of the conduit and vertically to the top of the conduit. Then place for a depth of 12 inches structural backfill over the top of the pipe equal to the trench width centered on the pipe center line. Construct the embankment outside the limits of the backfill. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch or less, place and compact structural backfill above the bedding for the full depth of the trench.
8. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
 9. All fill soils shall be placed in accordance with the article "Compaction of Soil Backfills and Fills" from the Earth Moving Specification Section 31 20 00.
 10. Coordinate backfilling with utilities testing.
 11. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
 12. Place and compact final backfill of satisfactory soil material to final subgrade.

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install

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- gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
 - D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
 - E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
 - F. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 2 percent unless otherwise indicated.
 - 2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 - 3. Install piping with 48-inch minimum cover.
 - 4. Install PVC corrugated smooth interior sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 5. Install PVC profile sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 6. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 7. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
 - G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join PVC corrugated smooth interior sewer piping according to ASTM D 2321.
 - 2. Join PVC profile sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
 - 3. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.

4. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
 5. Join dissimilar pipe materials with nonpressure-type, flexible couplings.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Unshielded flexible or rigid couplings for pipes of same or slightly different OD.
 - b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.5 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.
 1. Use Medium-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.

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2. Use Heavy-Duty, top-loading classification cleanouts in paved foot-traffic or vehicle-traffic service areas.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- B. Make connections to existing piping and underground manholes.
 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

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4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Connect to grease and oil interceptors specified in Section 22 13 23 "Sanitary Waste Interceptors."

3.8 CLOSING ABANDONED SANITARY SEWER SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 1. Close open ends of piping with at least 8-inch- thick, brick masonry bulkheads.
 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
 1. Remove manhole and close open ends of remaining piping.
 2. Remove top of manhole down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Section 312000 "Earth Moving."

3.9 IDENTIFICATION

- A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
 1. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.10 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate report for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.

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- d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
- 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Test plastic gravity sewer piping according to ASTM F 1417.
- 7. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.
 - a. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
- 8. Manholes: Perform hydraulic test according to ASTM C 1244.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.11 CLEANING

- A. Clean dirt and superfluous material from interior of piping.

END OF SECTION

SECTION 33 42 00

STORMWATER CONVEYANCE

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. Pipe and fittings.
 - 2. Nonpressure transition couplings.
 - 3. Cleanouts.
 - 4. Manholes.
 - 5. Catch basins.
 - 6. Stormwater inlets.
 - 7. Pipe outlets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Manholes: Include plans, elevations, sections, details, frames, and covers.
 - 2. Catch basins and stormwater inlets: Include plans, elevations, sections, details, frames, covers, and grates.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
- B. Field quality-control reports.

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1.5 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.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

- A. 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 requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Architect's written permission.

PART 2 - PRODUCTS**2.1 GENERAL:**

- A. Public Roadway Culverts: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 611.02, Type A Conduits.
- B. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 611.02, Type B Conduits.
- C. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 611.02, Type C Conduits.
- D. Private Drive Pipes and Bikeways: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 611.02, Type B Conduits.

2.2 DUCTILE-IRON, CULVERT PIPE AND FITTINGS

- A. Per ODOT 748.01 conforming to ANSI/AWWA C151/A21.51, service and extra-heavy classes, for gasketed joints. Fittings in first paragraph below should be available in NPS 3 to NPS 48 (DN 80 to DN 1200).

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- B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
- C. Compact Fittings: AWWA C153, for push-on joints.
- D. Gaskets: AWWA C111, rubber.

2.3 PE PIPE AND FITTINGS

- A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.
- B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S or Type D, with smooth waterway for coupling joints.
 - 1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
 - 2. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

2.4 PVC PIPE AND FITTINGS

- A. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.
- B. PVC Corrugated Smooth Interior Sewer Piping:
 - 1. Pipe: ASTM F 949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
 - 3. Gaskets: ASTM F 477, elastomeric seals.
- C. PVC Profile Sewer Piping:
 - 1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM D 3034, PVC with bell ends.
 - 3. Gaskets: ASTM F 477, elastomeric seals.
- D. PVC Type PSM Sewer Piping, pipe diameters 15" or less:
 - 1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
 - 2. Fittings: ASTM D 3034, PVC with bell ends.

3. Gaskets: ASTM F 477, elastomeric seals.

2.5 CONCRETE PIPE AND FITTINGS

- A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.

1. Per the latest version of the ODOT Construction and Material Specifications and as noted on the Drawings.
2. Bell-and-spigot or tongue-and-groove ends and sealant joints with ASTM C 990, bitumen or butyl-rubber sealant.
3. Class IV, Wall C.

2.6 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 1. For Concrete Pipes: ASTM C 443, rubber.
 2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
 1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Shielded, Flexible Couplings:
 1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- E. Ring-Type, Flexible Couplings:

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1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.7 CLEANOUTS

A. PVC Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
2. Frame and cover: Heavy-duty, H-20 rated, cast iron.

2.8 MANHOLES

- A. Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.

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10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile or ASTM A 48/A 48M, Class 35 gray iron unless otherwise indicated.

2.9 CONCRETE

- A. Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:
 1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- C. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
 1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.
- D. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 1 percent through manhole.

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2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 4 percent.
- E. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
 1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.10 CATCH BASINS

- A. Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. Standard Precast Concrete Catch Basins:
 1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
 3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
 4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
 7. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
 8. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 9. Frames and Grates:

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- a. Are to be heavy duty.
- b. Are to ADA compliant when located in hard surface areas.
- c. Are to be bicycle safe.

2.11 STORMWATER INLETS

- A. Curb Inlets: Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. Gutter Inlets: Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- C. Combination Inlets: Per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- D. Frames and Grates: Heavy duty, bicycle safe, per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.

2.12 PIPE OUTLETS

- A. Head Walls and End Walls: Cast-in-place reinforced concrete, with apron and tapered sides, per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. Riprap Basins: Broken, irregularly sized and shaped, graded stone per the latest version of the ODOT Construction and Material Specifications and as indicated on the Drawings.

PART 3 - EXECUTION**3.1 EARTHWORK**

- A. General:
 - 1. Conduit Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 611.02, Type B Conduits.
 - 2. Conduit Not Under Pavement: Refer to The Ohio Department of Transportation Construction and Material Specifications Item 611.02, Type C Conduits.
- B. Excavation For Utility Trenches:
 - 1. Excavate trenches to indicated slopes, lines, depths, and invert elevations.

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2. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
3. Excavate trench walls per ODOT Item 611.05 and geotechnical report as identified on the Drawings.
4. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches below invert elevation to receive bedding course.

C. Utility Trench Backfill:

1. Place and compact bedding course as required by ODOT specifications Item 611.06 and geotechnical report. Type 2 bedding consists of structural backfill extending at least 3 inches (75 mm) for all ODOT Item 706 rigid pipe conduits and 6 inches (150 mm) for all other conduits below the bottom of the conduit for the full width of the trench. Extend the bedding up around the pipe for a depth of not less than 30 percent of the rise of the conduit. Shape the bedding to fit the conduit with recesses shaped to receive the bell of bell-and-spigot pipe. Leave the bedding below the middle one-third of the pipe span uncompacted. Compact the remaining bedding according to ODOT Item 611.06.
2. Use Type 2 bedding for Types A, B, C, and D conduits except for long span structures and for conduits that require Type 3 bedding.
3. Type 3 bedding consists of a natural foundation with recesses shaped to receive the bell of bell-and-spigot pipe. Scarify and loosen the middle one-third of the pipe span.
4. Use Type 3 bedding for Type C and Type D conduits of the following materials: ODOT Items 706.01, 706.02, or 706.03.
5. Structural backfill for ODOT Item 611 bedding and backfill shall consist of limestone, gravel, natural sand, sand manufactured from stone, or foundry sand. Provide Type I or Type II structural backfill per the requirements of ODOT Item 703.11
6. Non-structural backfill should consist of clean, inorganic soil free of any miscellaneous materials, cobbles, and boulders. The fill should be placed in uniform, thin lifts and carefully compacted to a unit dry weight equal to 100 percent in structure areas and at least 98 percent of the maximum dry weight below pavement areas. The moisture content of the fill should be maintained at -2 to +1 percent of the optimum moisture content as determined in the laboratory by the Standard Test Methods for Moisture-Density Relations of Soils

(ASTM D 698). Fill should not be placed in a frozen condition or upon a frozen subgrade.

7. Place backfill to the limits described and according to the compaction requirements of ODOT Item 611.06. Place the backfill in the trench and embankment outside the trench uniformly on both sides of the conduit for all conduit installations.

- a. Type A and B. Backfill Types A and B conduits except for long span structures as follows

- 1) In a cut situation, place and compact structural backfill above the bedding for the full depth of the trench. Within the trench and more than 4 feet (1.2 m) above the top of the conduit, if the trench can accommodate compaction equipment, the Contractor may construct Item 203 Embankment. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
- 2) In a fill situation, place and compact structural backfill above the bedding for the full depth of the trench specified in 611.05. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and to a depth of 2 feet (0.6 m) above the top of the conduit. Construct the embankment outside the limits of the backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.

- b. Type C and D. Backfill Type C and D conduits as follows:

- 1) In a cut situation, for plastic pipe, place and compact structural backfill above the bedding and to 12 inches (300 mm) over the top of the pipe. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.
- 2) In a fill situation, for plastic pipe, place and compact structural backfill above the bedding for the full depth of the trench specified in 611.05. Above these limits, uniformly place the lesser of one pipe

span or 4 feet (1.2 m) of structural backfill on each side of the conduit and vertically to the top of the conduit. Then place for a depth of 12 inches (300 mm) structural backfill over the top of the pipe equal to the trench width centered on the pipe center line. Construct the embankment outside the limits of the backfill. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.

8. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
9. All fill soils shall be placed in accordance with the article "Compaction of Soil Backfills and Fills" from the Earth Moving Specification Section 312000.
10. Coordinate backfilling with utilities testing.
11. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
12. Place and compact final backfill of satisfactory soil material to final subgrade.

3.2 PIPING INSTALLATION

- A. All installation shall be per the latest version of the ODOT Construction and Material Specifications item 611 and the latest version of the ODOT Standard Construction Drawings.
- B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

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- E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- F. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- G. Install gravity-flow, nonpressure drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow.
 - 2. Install piping with 12-inch minimum cover.
 - 3. Install ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
 - 4. Install PE corrugated sewer piping according to ASTM D 2321.
 - 5. Install PVC corrugated smooth interior sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 6. Install PVC profile sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 7. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 8. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

- A. All joint construction shall be per the latest version of the ODOT Construction and Material Specifications item 611 and the latest version of the ODOT Standard Construction Drawings.
- B. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
 - 2. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
 - 3. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
 - 4. Join PVC corrugated smooth interior sewer piping according to ASTM D 2321 for elastomeric-seal joints.
 - 5. Join PVC corrugated smooth interior sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
 - 6. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.

7. Join PVC Type PSM sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
8. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
9. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 1. Use Medium-Duty, top-loading classification cleanouts in earth or unpaved foot traffic areas.
 2. Use Heavy-Duty, top-loading classification cleanouts in paved foot traffic, vehicle traffic, roads, and service areas.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 MANHOLE INSTALLATION

- A. General: Installation shall be per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings. Install manholes, complete with appurtenances and accessories indicated.
- B. General: Install manholes, complete with appurtenances and accessories indicated.
- C. Install precast concrete manhole sections with sealants according to ASTM C 891.
- D. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
- E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION

- A. Installation shall be per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. Construct catch basins to sizes and shapes indicated.
- C. Set frames and grates to elevations indicated.

3.7 STORMWATER INLET AND OUTLET INSTALLATION

- A. Installation shall be per the latest version of the ODOT Construction and Material Specifications and the latest version of the ODOT Standard Construction Drawings.
- B. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
- C. Construct riprap of broken stone, as indicated.
- D. Install outlets that spill onto grade, anchored with concrete, where indicated.
- E. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- F. Construct energy dissipaters at outlets, as indicated.

3.8 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.9 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 22 14 13 "Facility Storm Drainage Piping."
- B. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating

an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

- a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Shielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.10 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.

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2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
1. Remove manhole or structure and close open ends of remaining piping.
 2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Section 31 20 00 "Earth Moving."

3.11 IDENTIFICATION

- A. Materials and their installation are specified in Section 31 20 00 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.12 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.

- e. Exfiltration: Water leakage from or around piping.
- 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
- 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.
 - c. Option: Test concrete piping according to ASTM C 924.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.13 CLEANING

- A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION